THE UNIVERSITY OF ALBERTA

A GENERAL EQUILIBRIUM MODEL OF THE DEMOGRAPHIC TRANSITION IN SUB-SAHARAN AFRICA

by

RODRIGO BERRIOS LOYOLA ©

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled a GENERAL EQUILIBRIUM MODEL OF THE DEMOGRAPHIC TRANSITION IN SUB-SAHARAN AFRICA submitted by RODRIGO BERRIOS LOYOLA in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY in DEMOGRAPHY.

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ABSTRACT

This research examines the influence of alternative policy scenarios on the timing of the demographic transition in a stylized modern Sub-Saharan economy. This economy is characterized by a high fertility regime and in many respects resembles Kenya.

To this end, a general equilibrium model with complex economic-demographic links capturing essential dualistic features of this stylized economy was developed. The model permits an analysis of the period 1970 to 2000 and some speculative insights beyond the year 2000.

This research does not estimate the determinants of fertility in the stylized country modeled. Instead, it relies on theoretical views of African demography to develop a perspective on the key factors which drive fertility. Rural fertility is assumed to rise slightly during the first stages of development and to decline only after a developmental threshold is reached. Urban fertility is assumed to decline continuously as socioeconomic development proceeds.

The foregoing fertility specification is found to replicate the stylized facts of the representative African economy more closely than competing specifications. Hence, it is used to do most of the policy analysis. Some key policy scenarios are assessed using alternate fertility specifications.

What is most striking in the policy simulation analysis is the suggestion that conditions of strong economic growth would not produce a significant decline in fertility by the year 2000. The explanation of this outcome is in the core dualism of the economy which delays the increase in rural real wages and produces strong outmigration to the cities of the educated rural population. This finding is qualified by showing that fertility tastes may start changing at certain level of income per head. If this is the case, even modest rates of economic growth would lead to a faster fertility decline in the stylized economy during the nineties.

Other policy scenarios are discussed: basic needs, population control and policies affecting urban wages. The model, given its speculative nature common to simulation models, does not offer conclusive policy answers. It offers, however, valuable policy insights into the nature of economic-demographic relations in a dualistic economy.

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INTRODUCTION

The purpose of this research is to assess the implications of alternative policy scenarios on the demographic transition in most advanced Sub-Saharan countries during the period 1970-2000, and thus to derive policy guidelines for the acceleration of the demographic transition in Sub-Saharan Africa.

A necessary product of this research is an economic-demographic model which yields results consistent with the historically observed development pattern in the region. However, Sub-Saharan countries are not identical in their development performance, even though they do possess a number of common characteristics. Therefore, the model by necessity is that of a hybrid African economy, resembling closely the economies of Kenya, Ivory Coast, Nigeria and Zimbabwe.

In trying to explain the development pattern of this hybrid African economy, it was first necessary to outline the salient structural features of the represented economies. Demographic and economic policies have to be evaluated in the context of the structure of economic activity for the countries under consideration. The developmental pattern does not emerge out of "thin air". Rather, it constitutes the outcome of a vast array of economic and demographic interactions that occurs in the context of specific institutions, which might differ significantly from those of developed countries. One must be able to assess first, how the developmental pattern emerges, and thence to outline the channels through which various demographic and development policies would affect it.

Hence, the manner in which the institutional framework of these economies is incorporated into the model specification is a key element in the contribution of the thesis to understanding the demographic and economic dynamics of the represented Sub-Saharan countries. This methodology borrows from the "recursive modeling approach" of Day and Cigno (1978), in which institutional variations, and the reactions of economic and social agents to them, are crucial determinants of the developmental and demographic outcome.

Once the generation of the development pattern is understood, it is easier to evaluate how economic and demographic policies can alter it. The pattern itself, is not immutable, corresponding to the particular outcome of economic and demographic interactions which must be modeled.

Thesis Structure

The thesis is organized into seven chapters. In the first chapter, the development record of eight related Sub-Saharan economies in the last twenty-thirty years is reviewed (e.g. economic growth, internal migration, poverty and population growth). This review identifies crucial policy issues and competing policy prescriptions.

Chapter two provides a theoretical framework for understanding the demographic transition in countries at low levels of development. The chapter provides a review of competing hypotheses about the links between fertility and an array of economic-demographic variables that focuses on two polar cases. The first is that of the basic needs perspective, in which fertility reduction is ultimately brought about by enhancing economic security and increased health and education. The other case sees rises in income per head which through a variety of channels is the single most important determinant of fertility change. The latter perspective can be also interpreted as income per head being a proxy for modernization effects, which by themselves lead to the decline in fertility.

Chapter three is a critical review of the most relevant economic-demographic simulation models of developing countries in the last 20 to 30 years. The review illustrates how the crucial population-related policy issues have been modeled under alternative working hypotheses.

Chapter four describes the specification and solution algorithms of the model used by this research. Chapter five assesses the ability of the model to replicate and explain the historical pattern of development of the stylized economy under alternate specifications of the determinants of fertility. The results of the basic case simulation which reproduce the pattern of development are discussed.

Chapter six is a discussion of the economic-demographic implications of competing policy scenarios assessed in the context of our simulation exercise. These simulation experiments are the base for an insight into the economic-demographic dynamic in Sub-Saharan Africa over the course of the next decade.

Chapter seven presents the conclusions of this research.

1. THE DEVELOPMENT RECORD OF HIGH-FERTILITY AFRICAN COUNTRIES AND POLICY ISSUES

In this chapter, the development record of eight African countries during the last twenty to thirty years is reviewed. This examination seeks to set the main economic-demographic features of the stylized economy which provides the framework for the simulation exercise of this research. It also seeks to identify the nature of the different policy issues emerging from such scenario.

The simulation exercise covers the period 1970-2000, thus, it mostly reproduces history and to a minor extent forecasts the future. Accordingly, the examination of data attempts to determine mostly long term trends of African development. In doing this, a balanced review of past and more current information has to be observed.

The specific countries analyzed, were chosen because of a similar demographic profile, using criteria originally set out by Faruqee and Gulhatti (1983).

1.1 The Demographic Record in Africa

The demographic evolution of these selected African countries (AFS hereafter) during 1965 to 1987 is displayed in table 1.1.[1]

The rates of population growth of the AFS are mostly on the high side, in the range of three to four percent in 1987. The salient feature in the composition of these rates is that fertility has declined little, and according to other information sources it has risen, in some instances (United Nations, 1987). Mortality, on the other hand, has followed a more conventional course, declining at decreasing rates.

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[1] All tables are located at the end of the respective sections

There are few grounds to expect a rapid decline in fertility in the AFS in the foreseeable future. Some demographers see even a potential for increases in fertility. For instance, they argue that sub-fecundity still present in several African regions, caused by malaria and venereal diseases, might be significantly reduced in the near future by relatively inexpensive health measures reducing the incidence of these diseases. The reduction in sub-fecundity might translate in turn in a sharp rise in fertility (Romaniuk, 1978; Bongaarts et al., 1984). [3] In addition, they argue that the transformation of indigenous cultural values to western ones, is relaxing traditional customs (taboos) which served to regulate fertility. For instance, the duration of the breast-feeding period is being shortened, extending the period in which women are fertile. Thus, as this cultural transformation proceeds, fertility might rise (Bongaarts et al., 1984; Frank and McNicoll, 1987; United Nations, 1987).

Above all, it is difficult to see a significant change in the socioeconomic conditions, determining the rationality for high fertility in Africa, in the foreseeable future. These conditions are the prevalence of a peasant mode of production, low standard of living of the population, and ultimately acute under-development (Pradervand, 1989; Epstein and Jackson, 1977; Egero, 1980; Caldwell, 1976; Piche, 1974; Handwerker, 1986; Frank and McNicoll, 1987).

---

[3] Undernourishment also depresses fecundity, though its weight is substantially less than the factor of disease (Bongaarts et al., 1984).

In the light of the above, the small decline in the crude birth rates in the AFS, from 50 in 1965 to 47 in 1987, might be interpreted, in general, as fertility declining in urban areas while remaining high, and even rising toward natural limits, in rural areas. Some empirical evidence supports this interpretation (United Nations, 1987; Page, 1988; Obudho, 1979; World Bank, 1980; Faruqee and Gulhati, 1983; Anker and Knowles, 1983). Nevertheless, demographic information from Africa is sufficiently inaccurate to make this interpretation somewhat questionable (Page, 1988). Theoretically, the interpretation makes sense provided there is no reason to expect fertility declines in rural areas. Urbanization might represent the only possible break of the high fertility rationality in the African context, albeit weak (Caldwell, 1976, 1977). This point is developed further in the chapters following.

The future evolution of mortality, as suggested above, is one of slow progress. Indeed, mortality cannot be reduced much further by exogenous measures as it has been done mostly up to now, e.g. eradicating malaria by DDT spraying, and providing a minimum level of health care expenditure

(Ewbank, 1988; United Nations, 1984; Pradervand, 1989; Caldwell, 1975). Future reductions in mortality below the Kenyan crude death rate of 11 in 1987, will require reduction in poverty-related diseases and specifically, the reduction of undernourishment. This, in turn, requires significant improvements in the standard of living (Ewbank, 1988). The bleak economic prospects for Africa in the nineties (World Bank, 1989), corroborate the unlikelihood of reducing mortality further, and there may be even the possibility of a mild increase in the level (Ewbank, 1988). [3]

In conclusion, population growth in the AFS is expected to continue to be high by the year 2000, in the range of three to four percent. Unfortunately, it is not possible to provide a more precise pattern of population growth in the AFS. There are socioeconomic differences among these countries which determine the differentials in fertility and mortality among them. Thus, a conservative assessment for a pattern of population growth in the AFS is the one displayed by the simple average country in table 1.1.

The average rate of natural increase of the eight selected AFS, in 1987, was 3.3 percent. This high rate of population growth is considered by some development analysts as a crucial obstacle to African development (World Bank, 1981; World Bank, 1984; Faruqee and Gulhati, 1983; Frank and

---

[3] This brief overview of mortality trends in the region does not take into consideration the still unknown impact of AIDS (Ewbank, 1988).

McNicoll, 1987). For other analysts, rapid population growth is not necessarily an obstacle to development and the emphasis on the issue is seen as masking the real causes of under-development (Pradervand, 1989; Simon, 1976, 1977, 1981, 1987; Conroy et al., 1981; Egero, 1980). The review of this discussion and the policy issues relating to population and development is undertaken in the following sections of the chapter. In chapter two, a more specific discussion of fertility and its related policy framework is provided.

TABLE 1.1

DEMOGRAPHIC PROFILE OF SELECTED AFRICAN COUNTRIES
PERIOD: 1965-1987

Country	Year 1965			Year 1987		
	Crude Birth Rate	Crude Death Rate	Natural Increase Rate	Crude Birth Rate	Crude Death Rate	Natural Increase Rate
Zaire	47	21	26	45	14	31
Kenya	52	20	32	52	11	41
Sudan	47	24	23	44	16	28
Nigeria	51	23	28	47	15	32
Ghana	47	17	30	46	13	33
Tanzania	49	22	27	50	14	36
Zimbabwe	55	17	38	44	11	33
Ivory Coast	52	22	30	51	15	36
Average(a)	50	20	29	47	14	34

Source: World Bank Report 1989

a-Approximate average

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1.1.1 Economic Growth and Increasing Indebtedness

Economic growth has been slow in these selected African countries, during the period 1960-1982. Income per head for the AFS, on average, grew at an annual rate of 1.2 percent (table 1.2). In comparison, in the lower middle income developing countries, income per head grew at an annual rate of 3.2 percent, while in developed countries it grew at a rate of 3.3 percent.

The external debt of the AFS also increased considerably during the period, from 17 percent of GNP in 1970 to 96 percent of GNP in 1987 (columns 3 and 4). In comparison, the debt for developing countries in 1987 represented only 42 percent of GNP (World Bank, 1989). In sum, the above picture portrays in simple terms the economic stagnation and crisis in Africa.

In analyzing correctly the AFS economic growth reality, however, it is necessary to distinguish between two groups of countries: one with a satisfactory economic growth record, and another with an extremely poor performance. In addition, it is necessary to distinguish among transitory and more permanent economic trends.

A relatively high external debt has constituted, to a certain extent, a permanent feature of African development during the last twenty five years. This is due partly to an unprecedented involvement of Western Development agencies in Africa, relative to other continents. Official aid in proportion to GNP has been significantly higher in Africa than for the rest of the Third World (World Bank, 1981). In addition, international banks during the seventies permitted the accumulation of debt in the Third World. The high African external debt in the 1980s also reflects the effects of various external shocks including the oil price rise of 1973 and the sharp recession of 1982-1983. In this period, African exports declined more than those of the rest of developing countries, and interest rates on external loans increased significantly (World Bank, 1989).

Global economic growth reflects the economic constraints of the eighties. In the AFS, the annual rate of growth of income per head of 1.2 during the 1960-1980 period, falls to zero when considering the period 1965-1987. It is also important to distinguish between the satisfactory and successful economic growth records of Kenya, Nigeria, the Ivory Coast and Zimbabwe (sample 1), and the poor ones of Ghana, Sudan, Tanzania and Zaire (sample 2). In the former group, income per head grew on average at a rate of 2.4 percent annually during 1960 to 1982. The rate falls to 1.2 percent if the period 1965-87 is considered. These rates constitute actually strong economic growth performances, considering that the population growth rates in these countries were extremely high. That is, total national income or GDP grew at annual rates of 6.4 percent in Kenya, 6.8 percent in the Ivory Coast, and 6.9 in Nigeria during most of the last 25 years (1965 to 1980 approximately). Indeed, these economies were called the economic miracles of

Africa. These rates of growth were substantially greater than those displayed by developed countries, 3.7 percent (Ghai and Radwan, 1983; World Bank, 1981, 1984, 1989).

Ghana, Sudan, Zaire and, to a certain extent, Tanzania, instead, display a disastrous record of economic growth. Specifically, in Sudan, Zaire and Ghana, income per head grew negatively during the sixties and seventies, and in the eighties the rate of decline has become even higher. For Tanzania, income per head growth turns from positive in the sixties and seventies, to negative in the eighties. The latter group of countries is thus most representative of the typical Sub-Saharan countries, with bleak prospects for the nineties. Indeed, the World Development Bank Report 1989, predicts a zero rate of growth in income per capita for this group under the most optimistic assumptions (World Bank, 1989).

TABLE 1.2

OVERVIEW OF ECONOMIC GROWTH AND EXTERNAL DEBT--SELECTED AFRICAN COUNTRIES

Country	Income Per Head Growth Rates		External Debt percentage of GDP	
	1960-80.	1965-87.	1970.	1987.
Zaire	-0.3	-2.4	9.1	139.5
Kenya	2.8	1.9	26.3	64.3
Sudan	-0.4	-0.5	a	101.9
Nigeria . . .	3.3	1.1	4.3	111.3
Ghana	-1.3	-1.6	23	45.3
Tanzania . . .	1.9	-0.4	20.7	144
Zimbabwe . . .	1.5	0.9	a	37
Ivory Coast .	2.1	1.0	19.5	124
African Sel.C. Average . . .	1.2	0	17.15	95.9
Sample 1 . . .	2.4	1.2	16.7	84.0
Sample 2 . . .	-0.02	-1.2	17.6	107.6

a: information not available
Sample1: Kenya, Nigeria, Zimbabwe and The Ivory Coast
Sample2: Zaire, Sudan, Ghana and Tanzania
Sources: World Bank Reports 1984, 1989.

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1.1.2 Internal Factors Underlying Economic Stagnation and Policy Issues: Right Prices, Accelerated Rural Development and Population Control

Abstracting from external and transitory factors, there are domestic factors which have played an important role in creating economic stagnation in the AFS. The World Bank points at the urban bias of development in Africa, as the most important of these internal factors (World Bank, 1981, 1984, 1989). The urban bias means essentially the neglect and squeezing of agriculture in order to favour the industrial sector. In short, this bias translates into a policy induced deterioration of the relative prices of agricultural products, faced by producers. This is achieved by several mechanisms: overvalued exchange rates, tariffs protecting industry, and high export taxes, among them. The market signals associated with urban biased policies discourage agricultural and staple export producers from investing in new technologies and capital goods, and reduce the contribution of this sector to aggregate growth. The result is the gradual decline of the economy's capacity to import, and ultimately its autonomous capacity to grow.

The World Bank and the ILO have documented this phenomenon for several African countries, concluding that the greater the neglect of agriculture, the greater the magnitude of the economic crisis. Ghana, at one extreme, with its disastrous economic growth performance (see table 1.2) is cited as the epitome of "urban bias" policies (World

Bank, 1981). On the other extreme, the relatively successful economic experiences of Kenya and the Ivory Coast are explained by the lesser degree of neglect of agriculture. [4]

The policy guidelines which emerge from this diagnosis are those of "setting the prices right" and promoting rural development. The former, seeks for producer-prices of agricultural goods more in line with world prices. The latter, emphasizes the need for further agricultural technological assistance, technological agricultural research and building of necessary economic infrastructure.

The World Bank sees rapid population growth as another major impediment to economic development in the region. [5] In connection with the above policy issue of agricultural neglect, rapid population growth is seen as exacerbating the trend for the exportable agricultural surplus to be depleted and making fairly difficult the necessary upgrading of human capital in Africa. And sometimes, rapid population growth is seen as affecting savings formation negatively. [6]

Hence, the policy prescription which follows from the World Bank perspective is that population growth be reduced in Africa. The means to achieve this reduction, however, are really unknown for the African case, wherein the traditional prescription of birth control simply has not worked (World Bank, 1980, 1981, 1984, 1989; Faruqee and Gulhati, 1983; Frank and McNicoll, 1987).

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[4] Even though, both of these countries have also transferred a considerable agricultural surplus to finance industrialization, in the case of Kenya, and a costly urbanization, in the case of The Ivory Coast (Ghai and Radwan, 1983).

[5] Even though the negative World Bank's view on rapid population growth has become milder, which is clear in the World Bank Development Report 1984, this remains clearly negative in the case of Sub-Saharan Africa. See Faruqee and Gulhati (1983) and the World Bank Development Report 1989.

[6] See Birdsall (1977), and McNicoll's (1984) for a complete overview and assessment of the developmental consequences of rapid population growth.

1.1.3 Dissident Views on Development and Population

The World Bank policy guidelines summarize fairly accurately the main stream western view of economic development and its relation with rapid population growth. Nevertheless, there is neither consensus upon such diagnosis of the under-development malaise, nor on the negative view on population growth.

The most articulate opposition to the World Bank interpretation of development is provided by proponents of structural approaches to development or dependency theory. This theory, while agreeing on the immediate causes of the depletion of the exportable agricultural surplus, and on its implications, sees both of these causes and the crisis as the symptom of a deeper structural problem. Dependency theorists argue that the integration of developing countries as staple producers into a capitalist world system, which is inherently asymmetrical in political and economic power terms, will necessary be to their disadvantage. This asymmetry, and the inherent functioning of this world structure, unavoidably tends to produce more development for the industrial countries while permitting little development for the basic staple producers (Baran, 1957; Prebish 1962; Frank, 1969; Amin, 1972, 1976). This perspective would also see the "population problem" in Africa, and elsewhere as a consequence of induced under-development rather than as a cause of it. It is not possible within the scope of this research to further elaborate this approach nor to provide an assessment of it. [7] In sum, it is possible to say that this approach would see a generalized solution to under-development coming first from a change of the power relation between the First and the Third World. Population reduction would have only secondary importance in achieving development.

The negative view of rapid population growth has been contested also by mainstream demographers and economists, based on the following arguments.

First, they argue there is no empirical support for the hypothesis of a negative effect of population growth on economic growth (Stockwell, 1962; Kuznets, 1967; Thirlwall, 1978; Browning, 1979; Bairoch, 1981; Blanchet, 1985; Reynolds, 1985; Chesnais, 1987). Second, it is contended that population growth induces labour intensive and land saving technological change (Boserup, 1965, 1981; Gourou, 1965; Hayami and Ruttan, 1971; Kumar, 1973; Binswager and Ruttan, 1978; Simon, 1976, 1981; Hayami and Kikuchi, 1982). Third, the argument that higher fertility, by inducing a higher dependency rate, reduces savings in developing countries has also been rejected at both the theoretical and the empirical levels (Solow, 1957; Coale and Hoover, 1958; Leff, 1969; Enke, 1971). Bilsborrow, 1973, 1979; Gupta, 1975, 1982; Mason, 1987; Kelley et al., 1972).

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[7] See Boulding (1988) and Todaro (1984) for a sympathetic evaluation from the Western main stream point of view.

Among the above arguments, only the last one is currently accepted without qualifications. All the other ones have been, in turn, contested.

The dissident view which argues that there is no negative effects of rapid population growth on economic growth is based on empirical studies with methodological shortcomings. These are cross country analyses, which mix developing countries with a wide variation in natural resources, human densities, technological change and foreign investment, which renders their results irrelevant to prove any point (Ware, 1978; Repetto, 1985; National Research Council, 1986).

Furthermore, the argument of a possible positive effect of population growth on technological change, has been strongly criticized on several grounds. First, the evidence indicates that technological change in the Third World is institutionally and exogenously induced. Second, the institutional capacity of developing countries to promote technological change is hampered by their low endowment of human capital which, in turn, is inversely related with rapid population growth. Third, relative prices do not function adequately in the Third World, thus price mechanisms are unlikely to induce technological change a la

Ruttan (Hayami and Ruttan, 1971; Hayami and Kikuchi, 1982; Binswanger and Ruttan, 1978). Fourth, the evidence in Africa points at massive examples of rapid population growth inducing negative technological change: e.g. malnourishment, illness, and ecological degradation (McNicoll, 1984; Eicher, 1984).[*]

Two points should be raised after reviewing these competing views. The first is the need for more caution with regards to evaluating the population problem. These are very strong and opposing view regarding the impact of rapid population growth on income per capita and socio economic variables in the African context.

The second point which will be elaborated upon in more detail later is that the linkages between population growth and its effects on economic and demographic variables is diffused and multi channeled. Therefore, it is best to assess in the context of a large scale economic-demographic model in which all the various linkages among economic-demographic variables and institutional linkages can be specified.

1.2 Income Distribution and Economic Growth: Has the Standard of Living of the African Improved?

The ILO information suggests that vast segments of African population have not experienced an improvement in their standard of living during the last thirty years. Furthermore, it suggests that due to the interaction of population pressure, the urban bias of domestic policies, and land scarcity, the income distribution might have actually deteriorated. Poverty is on the rise in Africa unless Africa`s more urgent economic problems are tackled (ILO, 1972; Ghai and Radwan, 1983; Livingston, 1986).

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[*] Negative technological change is interpreted here as rapid population growth inducing a reduction in the output-input ratios.

In the analysis of poverty and income distribution, it is necessary to distinguish several situations. An obvious first distinction should be established among those countries with poor economic growth record and those with strong records. Ghana, for instance, might be a country representative of the former group. In this country, income per head is currently about the same as it was in 1950 (Ghai and Radwan, 1983; World Bank, 1989).

In countries with strong economic performance, the advances of development were not shared by the whole population. In Nigeria, the oil boom in the seventies, seems to have raised the standard of living of urban workers, whilst it impoverished the peasants (Collier, 1983). The result to certain extent was unavoidable, given that the massive influx of dollars led to a sharp fall in the terms of trade of agricultural exporters.

The benefits of the "economic miracle" in the Ivory Coast were not shared by the whole population. Specifically, the miracle was achieved by extending the land frontier, using the vast amount of untapped land resources. The required labour arose from immigration from the Sahelian countries. In fact, 30 percent of the labour force in the Ivory Coast was foreign workers (Amin, 1965; Lee, 1983), already in the early 1970's. Rural real wages remained constant and even decreased in light of this immigration. In addition, the exports growth strategy relied mostly on big estates and big farms rather than on small farms. In sum, big farmers and estate owners gained most of the benefits of development. Of course, one can question whether government expenditure ameliorated this situation.

In Kenya the expansion of agricultural exports was achieved basically by the small-medium farms sector (World Bank 1975, 1980, 1981; Killick, 1981; Livingston, 1986). The reason, in part, is that land redistribution subsequent to independence was more widespread in Kenya than in the Ivory Coast and Nigeria. In turn, the reasons for this more radical initial land redistribution, and the resultant greater role for the small-farms sector in agriculture, are ultimately political. They are rooted in the peasant revolutionary character of the independence struggle in Kenya, wherein, the main factor in mobilizing the peasantry was precisely the access to land (Leys, 1975). Thus, it should not come as a surprise that income distribution was better in Kenya than in the Ivory Coast and Nigeria (House and Killick, 1983).

An approximation to the income distribution situation in the AFS is provided in table 1.3. The infant mortality rate has been used as a proxy for the income distribution, due to the good correlation between these two variables, and because of the absence of data for the latter, e.g. Gini coefficients.[1] Income per head and the infant mortality rate of the AFS, in the year 1982, are displayed in the table.

The most striking result is that the Ivory Coast with the highest income per head among the AFS, about twice the average, displays the highest infant mortality rate (119). On the contrary, Kenya which ranks in the fifth place in income per head has the lowest infant mortality rate (77). The situation is very similar with Nigeria, which displays the second highest income per head but the third highest infant mortality among the eight AFS. Another interesting result is that Tanzania does not perform badly in terms of infant mortality, in comparison with its level of income. The reason for this is primarily due to the quasi-socialist orientation of this country, which pursued a policy giving priority to the satisfaction of basic needs (food, education and health) even at the cost of economic growth. The Tanzanian case is more extensively discussed in the next chapter.

The abundance of untapped land was crucial in preventing a rapid deterioration of the income distribution and in improving the welfare of the population in some of the AFS: e.g. Kenya and Zimbabwe. [10]In fact, several African governments practiced a policy of reallocating peasants from less to more advantaged ecological zones, and to resettle them when farms achieved a critical size due to rapid population growth (Killick, 1981, 1983). This policy has become increasingly difficult to pursue as land becomes scarce, land markets develop, and in general, capitalism becomes consolidated.

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[1] Income distribution data are still scarce. Some data on income distribution which corroborate the preceding discussion are presented in David (1986: 125).

The effect is clear in Kenya, with the highest rate of population growth among the AFS, and it will take some years to come in the more abundant land countries, e.g. Zaire (House and Killick, 1983). For instance, in Kenya, Greer and Thorbeeke (1985) and Livingston (1986), argue that land-scarcity has exacerbated food shortages and increased rural poverty. [11] Furthermore, the emergent African bourgeoisie increasingly uses its influence on the state in order to get the better land at more favorable conditions (House and Killick, 1983). On the other hand, most of the agricultural policies: e.g. credit and technological research, are big-farm biased (Eicher, 1984).

The above contrast between Kenya on the one hand, and the Ivory Coast and Nigeria, on the other, might give the impression that income distribution in Kenya is fairy equal. On the contrary, in Kenya, 46 percent of the land belongs to 2.5 percent of the rural land holders, while the remainder

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[10] Of course, it was important provided the political will to redistribute land, and not to squeeze the peasantry.

[11] Food shortages is the ILO criterion of poverty.

54 percent of land belongs to 97.5 percent of the rural households (World Bank, 1980; ILO, 1972; Livingston, 1986). Indeed, Kenya's income distribution according to Anker and Knowles (1983) is one of the worst in the world.

The analysis has centered on agriculture because Africa is still inherently rural. Indeed, 66 percent of the population for the AFS average country in 1987 was rural. And poverty is mostly concentrated in rural areas (Ghai and Radwan, 1983; Faruquee and Gulhatti, 1983).

TABLE 1.3

INCOME PER HEAD AND INFANT MORTALITY--SELECTED AFRICAN COUNTRIES AND OTHER--YEAR 1982

Country	Income Per Head	Ranking Income	Infant Mortality (below one year)	Ranking Inf. Mort.
Zaire . . .	190	8	106	5
Kenya . . .	390	5	77	1
Sudan . . .	440	4	119	7
Nigeria . .	860	2	83	6
Ghana . . .	360	6	86	3
Tanzania .	280	7	98	4
Zimbabwe .	850	3	83	2
Ivory Coast	950	1	119	7
Sri Lanka .	320	b	32	b
Mexico . .	2270	b	53	b
Brazil . .	2240	b	73	b

Sources: World Bank Report 1984--Dollars 1982.
b. nonrelevant for the analysis.

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1.2.1 The Policy Issues: Basic Needs versus a Non Interventionist State Approach

The fact that economic growth in the Third World does not improve evenly the standard of living of the population is a well-documented phenomenon (David, 1986; Chenery, 1960; Chenery and Syrquin, 1975; Chenery et al., 1974). The policy implications which follow, however, have divided the western conception of economic development into two perspectives. One insists upon the need for redistributing income in the earlier stages of development, even, if this entails some cost in foregone economic growth. This approach to development, known as "basic needs", embodies the philosophy that the satisfaction of minimum needs in food, health, clothing and education must come first in Third World development. Further, the satisfaction of these needs is seen as the essence of what development is all about (Streeten et al., 1981; Todaro, 1985). [12] This current of thought was influential on the World Bank behavior during the seventies, and it is still embodied in the philosophy of the International Labour Organization, ILO (Streeten et al., 1981).

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[12] The Basic Needs approach emerged from a dissatisfaction with the conception of economic development which assumed that the benefits of economic growth would "spill over" to the population in the Third World. Indeed, by the end of the sixties, it became evident that economic growth had done little for the poor, and/or that the expected "spill over" was not taking place. For instance, in Brazil, the income per head of the poor half of the population is estimated to have grown by less than 1 percent for the poor, while the of the richer half is estimated to have grown by 30 percent, during the sixties. In India, Pakistan, Bangladesh, Indonesia and the Philippines, it is estimated that the real income of the poorest 40 percent actually declined in the sixties (Streeten and Burki, 1978). In addition, the "basic needs" approach was importantly influenced by the fact that societies with a low level of income, e.g. China and Sri Lanka, achieved impressive advances in life expectancy, infant mortality, nourishment and education, which societies of 3-6 times higher level of income did not achieve. (Greenhald, 1990; Streeten and Burki, 1978; Gunatilleke,

The other perspective focuses on the danger of a premature redistribution of income since it might hinder economic growth. The fundamental argument is that basic needs can ultimately be satisfied only if there is economic growth. And basic needs approaches are seen as entailing government intervention in the market, whose free functioning, in turn, is considered as the key to overcome under-development. This current of thought is closely associated with the resurgence of conservativism in economics, and it has become clearly dominant in the World Bank in the eighties. Finally, a radical view of under-development would reject both conceptions, while more moderate currents of structural economic thought, e.g. "desarrollismo" associated with ECLA (Economic Commission for Latin America) would sympathize with the former approach.

What are the policy implications of both conceptions for the African case? In answering this question, one might look at the record of countries which have pursued basic needs policies versus the one of those which have not.

Developing countries and/or regions, which have pursued basic needs policies are Sri Lanka, the Indian state of

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[12](cont'd) 1982).

Kerala, the People's Republic of China, Taiwan, South Korea, and Cuba. The evidence emerging from these countries, reproduced elsewhere,[13] indicates that they have achieved mortality, educational and nourishment levels comparable with those of countries with income per head several times higher. For instance, in table 1.2, Sri Lanka displays a better infant mortality rate (32) in 1982, than most upper middle income developing countries, with average infant mortality of 58 and income per capita eight times higher. Of course, Sri Lanka beats all of the African "miracles" with income per head three times higher, e.g. Nigeria and the Ivory Coast.

In conclusion, it appears that the record of basic needs is fairly superior in education and health to the one exhibited by the laissez-faire examples, e.g. the Ivory Coast. In some cases, the record in social needs has also been accompanied by strong economic growth: e.g. the People's Republic of China and Taiwan (World Bank Reports, 1984, 1989).

Even though basic needs policies might present important differences, e.g. between China and Taiwan, one can identify among them some common features. Basically, they share a redistributive emphasis, which seeks to raise the productivity of the poor. The approach thus emphasizes human capital formation in the sense that a better nourished, healthy and educated labour force might substitute, to an extent for physical capital accumulation (Streeten, et al. 1981; Todaro, 1985). For Africa, this necessarily translates into upgrading education and health, promoting technological change, and preventing income distribution from deteriorating. All of these measures imply strong state intervention, as the state must provide initially subsidized or free education, health and technical assistance, and must take measures to prevent the deterioration of income distribution: e.g. land reform. These measures, if they succeed in raising labour productivity, will also promote economic growth. In addition, they might produce an early fertility decline thus reducing population pressure. Finally, in the African context where most of the population is rural, these policies obviously entail the need for promoting rural development.

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[13] See Fernando (1976) for the case of Sri Lanka, Ratcliffe (1978) and Nag (1989) for the case of the Indian state of Kerala, Parrish and Whyte (1978) and Greenhald (1990) for the People's Republic of China, Freedman (1979) for Indonesia, Rich (1973) for the cases of Taiwan and South Korea, and Diaz-Briquets and Perez (1982) for Cuba. For a general review see Gunatilleke (1982).

1.2.2 The Constraints Faced By Basic Needs Policies: Technical or Political?

A development strategy which attempts to reconcile basic needs satisfaction with economic growth faces several obstacles. One alleged obstacle relates to the magnitude of the reinvestable surplus from which a redistribution might come. If this is too small, then income redistribution might deplete required funds for future investment, thus jeopardizing economic growth. The surplus is defined as the difference between what a society produces and what it consumes. The amount of the surplus relates in part to the distribution of consumption between rich and poor, but also to the productivity level of the society: product per worker. That is, in a subsistence society, the product that a worker is able to produce scarcely covers his needs, thus the surplus is small. In a modern technological society, the product that a worker produces, covers by far his needs, and the surplus is high (Taylor, 1979). This has given place to the view, e.g., that in Africa even a radical income redistribution would not improve substantially the welfare of the poor while it would deplete the reinvestable surplus (Streeten, 1981). The point highlights the need for the redistribution to be "productive", that is to raise product per worker. In Africa, the fact that small farms tend to be more efficient than big farms (Swan et al., 1987; Anker and Knowles, 1983) has been used to reconcile the above argument with the need for land reform (ILO, 1972).

In the assessment of basic needs policies there is certainly a strong ideological component. One perspective attempts to show that government intervention and quasi-socialist experiments are per se inefficient. For instance, the agricultural stagnation in Tanzania with social services badly deteriorating since 1978 (United Nations, 1989), as well as the economic difficulties of

Sri-Lanka, high unemployment and its increasing problems in maintaining a free provision of basic rice rations, and similar problems in China are examples cited to demonstrate the above point (Eicher and Staatz, 1984).

The above type of criticisms, however, may constitute an oversimplification of reality. For instance, the rates of growth in income per-capita, during 1960-1980, for Tanzania, Sri Lanka and China, were 1.9, 2.6 and 5 percent annually, substantially above the average for low level developing countries: 1.2 (Gutanilleke, 1982; World Bank, 1984). In addition, the argument that early redistribution of income hinders savings, and thus economic growth, disregards the fact that investment in developing countries may be low basically because savings are invested abroad (Mason, 1987). In conclusion, while it is impossible to demonstrate that basic needs are more efficient than a laissez faire course, it is also impossible to demonstrate the contrary.

The Political Problem

The most important constraint for implementing basic needs policies is political. In fact, the elites obviously do not have interest in redistributing either their income, via progressive taxation, or their wealth such as land.[14] The elites are neither interested in changing the orientation of the government expenditure from which they derive most benefits, nor in changing the orientation of development toward rural development, unless they can see clear benefits from it.[15]

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[14] See Todaro (1985).

Political resistance to these changes is documented elsewhere. For instance, the resistance toward the ILO (1972) plan for an extensive land reform and a social and economic program along basic needs lines in Kenya, can be found in Killick (1981). The political-ideological world context is also crucial in the possibility of implementing these programs. The illustration of this fact goes beyond the task here.[16] It suffices to mention that the basic needs approach fell into disfavor by the eighties with the World Bank (Eicher and Staatz, 1984).

In conclusion, the implementation of basic needs types of programs require the political support of important segments of the population to overcome several resistance of elites and other special interest groups. In addition, it needs a favourable international context. In the absence of these elements, it is possible only that social pressure from below might force governments to promote somewhat these policies (Nag, 1989; Gupta, 1979).

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[15] See Todaro (1985) for a general articulation of the above argument. See Selowsky (1979) for the case of government expenditure favoring clearly the elite. Blaug (1987) and Fields (1971), have argued that subsidies to secondary and university education in LLDCs are necessarily regressive. Linn (1983) has argued that subsidies in housing construction are generally used by the middle class rather than the poor in LLDCs; a general tone for the above effects is also given by Mohan (1977). This literature has often been associated with the World Bank, whose final working papers on housing, education, health and food contain the most coherent argumentation for the above general case.

[16] It suffices to mention a long history of hostility, if not frank clear North American aggression, toward governments which attempted minor assets redistributions in Latin America and Africa.

1.3 Agriculture, Population and the Environment in Africa

1.3.1 The Importance of Agriculture

The importance of agriculture in the AFS is illustrated in table 1.4. First, in terms of employment, agriculture employs the vast majority of the labour force, 69.5 percent in the average AFS (column 2) in 1980. And it will continue to do so, until at least the first quarter of the twenty-first century (Livingston, 1986). In table 1.5, it is shown that employment in agriculture in the average AFS has been growing at a rate of 2.4 percent annually during the last twenty years (column 4). Second, the percent of the labour force employed in agriculture gives an approximate idea of the proportion of households whose living depends on the land. In addition, the fact that 69 percent of the labour force produces only 33 percent of the national product,[17] indicates the low productivity of agriculture in Africa.

Such statistics highlight the dramatic need to raise agricultural productivity in order to raise the rural standard of living, and to feed the rapidly growing population. Finally, the large share of the rural population in the total population also indicates that massive rural-urban migration simply cannot be a solution to raise the standard of living in the AFS. The consequences of an acceleration in internal migration are discussed in the next section. In other words, the cities cannot absorb such magnitude of rural labour. Third, agriculture in several of the AFS still contributes the bulk of exports, e.g. 82 percent in the Ivory Coast and 94 percent in Sudan. In Kenya, which has turned to industrialization, agriculture still contributed 52 percent of total exports in 1981. The exceptions are Nigeria which is an oil exporter, and Zaire a zinc exporter. In sum, it is clear that for most of the AFS, agriculture still performs a strategic role in producing foreign exchange.

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[17] In contrast, 31 percent of the labour force, located in urban areas, produces 67 percent of the national income.

1.3.2 Agriculture Stagnation and Environmental Degradation: The Record of the Last Twenty-Thirty Years

The neglect of agriculture is illustrated in columns 3 to 5 of table 1.4. In column 3, it is possible to see that agriculture production per head, with an index 100 in 1970, declines to 87 in 1982. Similar information is displayed in columns 4 and 5. Therein, the decline in the rates of growth of agricultural product per head is shown. This evolves from an average rate of growth of 1.8 percent in the seventies to a rate of -1.25 percent in the eighties. Columns 6 and 7 display the consequent increase in food imports, which rise eight times approximately between 1970 and 1980. The increase in food imports does not tell us the whole picture, since food aid which has also increased considerably during the period under study is not included (World Bank, 1981).

The decline in food production per head in Africa has not taken place anywhere else in the world but in Sub-Saharan Africa during the last twenty years (Faruqee and Gulhati, 1983; World Bank, 1984, 1989). This decline poses a problem given that most of the AFS have not yet generated an alternative source of foreign exchange (Pradervand, 1989; Birdsall, 1980, 1984; Yotopoulos, 1983; World Bank, 1980, 1981, 1984; Killick, 1981; McCarthy and Mwangi, 1982). In addition, since most people in Africa depend for their living on agriculture, the decline in food production per head means an increase in undernourishment in the AFS, and raises the spectre of famines in the future (Eicher, 1984).

Rapid population growth is also badly pressing the African ecological system. For instance, spread of the desert in the Sahel has been associated with rapid population growth. Wood for fuel consumption has become scarce, and peasants have resorted to using other organic materials which speeds up the process of soil degradation. Overgrazing and shortening of the fallow periods, as well as rapid deforestation, are also observed everywhere with similar consequences (World Bank, 1981, 1984; Birdsall,1980, Club du Sahel, 1980). The extent of these problems naturally varies depending on the human density already existent in these countries.

TABLE 1.4

THE AGRICULTURE RECORD IN SELECTED AFRICAN COUNTRIES

Country	Agr. Share of GDP 1982	Agr. Share of Employm. 1982	Index Food Product per head 1982 (base:1970)	Ag.Product P/Head Rate of Growth		Food Imports		Agric.Exports % in total 1981
				1960-70	1970-80	1970	1980	
Zaire . . .	32	75	87	1.3	-1.5	63.4	165.5	18
Kenya . . .	33	78	88	0.1	-1.6	49.7	213.5	52
Sudan . . .	36	78	87	2.2	0.4	65	390	94
Nigeria . .	22	50	92	0.2	-0.7	127	2085	6
Ghana . . .	51	53	72	0.8	-3.5	77	131	73
Tanzania .	52	83	88	2.6	-0.7	32.4	164.8	76
Zimbabwe .	15	60	87	2.3	-2.8	10.8	61.9	50
Ivory Coast	26	79	109	4.8	0.4	82	486	82
Average . .	33.3	69.5	88	1.8	-1.25	63.3	462.2	

Source World Bank Reports 1984-1989

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TABLE 1.5

OVERVIEW OF ECONOMIC-POPULATION AND EMPLOYMENT GROWTH DISAGGREGATED BY SECTOR--SELECTED AFRICAN AND MORE DEVELOPED COUNTRIES PERIOD 1965-1980 -approx.-

Country	GDP Growth Growth Rate	Population Growth Rate	Agriculture Growth Rate		Manufactures Growth Rate		Services Growth Rate	
			Product.	Employm.	Product.	Employm.	Product.	Employm.
Zaire	b	2.8	b	2.3	b	4.6	b	4.8
Kenya	6.4	3.6	4.9	3.1	9.8	7.0	6.4	5.0
Sudan	3.8	2.8	2.9	2.3	3.1	5.3	4.9	5.8
Nigeria . . .	6.9	2.5	1.7	1.1	13.1	5.7	7.6	4.3
Ghana	1.4	2.2	1.6	1.2	1.4	4.0	1.1	3.2
Tanzania . . .	3.7	3.3	1.6	2.9	4.2	5.3	6.7	5.6
Zimbabwe . . .	4.4	3.1	b	2.4	b	4.6	b	4.2
Ivory Coast .	6.8	4.2	3.3	3.6	10.4	7.6	8.6	7.3
African Sel.C. Average . . .	4.83	3.1	2.7	2.4	7	5.5	5.9	4.9
Lower Middle Income	5.7	2.1	3.5	1.0	6.0	4.0	6.3	4.4
Industrial economies . .	3.7	0.9	0.8	-4.3	3.2	1.2	3.7	2.4

b: information not available
Sources: World Bank Report 1989. P166- rates of growth of GDP, and sectoral prod. rates. P214-populat. growth. World Bank Report 1984. P258-employment structure.
Note: the rates of empl.growth for the African countries were calculated using the rate of pop. growth as a proxy for the rate of growth of the labour force.

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1.3.3 Some Aspects of The Policy Issue Debate in Agriculture

The typical policy questions which emerge from this scenario refer to the possibilities for feeding the rapidly growing population in Africa, to the technological possibilities for increasing agriculture productivity, and to the ability of the ecosystem to sustain population pressure.

Neoclassical economists believe that agriculture will cope with the above challenges, provided the adequate market signals are given to producers (Ghai and Smith, 1987). In addition, they think that ecological pessimistic views are unfounded (Yotopoulos, 1977, 1983; World Bank, 1981, 1984; McCarthy and Mwangi, 1982; Srinivasan, 1988; Eicher, 1984; Srinivasan, 1988; National USA Research Council, 1986).

The optimistic view regarding the ability of agriculture to meet food demand, sometimes assumes that population growth will soon start declining in Africa, as development advances. [18] Indeed, the World Bank literature frequently attempts to show that this decline has already started. [19] This assumption is being increasingly contested in the demographic field. Many scholars have argued that the prospects for a near term fertility decline in Africa are unfounded (Caldwell, 1977; Berelson, 1978; Bongaarts, 1986; Bongaarts et al., 1984; Frank and McNicoll, 1987).

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[18] See e.g. "Kenya: Population and Development" (World Bank (1980), for a discussion of different assessments of food productive potential in Kenya.

[19] See World Bank (1981) and World Bank Report (1984).

The most difficult issue to assess is the ecological one. Some elements with respect to the African ecosystem are emerging. First, most of the Sub-Saharan is not an ecosystem suitable for agricultural expansion purposes. That is, the quality of the land is poor, there are extreme annual variations in rain fall, and water is in short supply (World Bank, 1981; Anker and Knowles, 1983; Council on Environmental Quality, 1981). These conditions have frustrated the efforts for adapting genetic technologies to double and triple yields of e.g. maize, wheat, used successfully in Asia and Mexico (Johnston and Kilby, 1975, Eicher, 1984).

Second, while neoclassical economists are confident that correct prices can deal with ecological issues, it is not clear that this is possible in the African context. The policy suggested "correct prices" often mean world prices which do not necessarily give account of future resource scarcities nor reflect negative externalities. Indeed, in the developed world it has proven extraordinarily difficult to ensure that all costs and social benefits are assessed in project analysis. The data problem can be more formidable in the Sub-Saharan Africa. Furthermore, in the African case where government policies protecting natural resources are presumably weak, "right prices" might compound the ecological problem, e.g. the rate at which forests are cut might be higher than a social optimum. In this case, a serious competing hypothesis to ecological-damage caused by rapid population growth is the one caused by "right prices". This may be the explanation for the rapid depletion of the rain-forest in the Ivory-Coast (Kneese, 1988; McNamara, 1985).

Finally, the potential for land expansion in Africa seems to be greatly exaggerated. In particular, the possibilities for expansion of the agricultural base at a reasonable cost are close to its end, in several regions e.g. Kenya. Some constraints to land expansion are related to endemic diseases, e.g. river blindness and sleeping sickness in several regions of Africa. Most constraints relate to water shortages (World Bank, 1984).

1.4 The Pattern of Rapid Urbanization and Rural-Urban Migration in Africa

The rate of urban growth in Africa has been extremely high by any comparative standards. Table 1.6 shows that urban areas in the AFS have been growing at annual rates close to 7 percent, since the 1970s. In comparison, urban areas in the lower middle income developing countries grew at an annual rate of 4.4 percent, and the upper middle income developing countries at 3.9 percent annually, between 1970 and 1982 (World Bank 1984). Furthermore, the United Nations (1980, 1988) estimates that the region will continue to grow at these high rates up to the year 2000, at least.

An important component of urban growth in Africa is constituted by internal migration. Even though the information is not accurate, sixty percent and sometimes seventy percent, of urban growth in Africa can be attributed to internal migration (Preston, 1979; Adepoju, 1988). This pattern contrasts with the one of more advanced developing countries, in which natural increase contributes most to urban growth, e.g. Latin America (Preston, 1978, 1979; Rogers, 1982).[20]

The information in table 1.6 can be used to illustrate the approximate contribution of internal migration to urban growth in the AFS.[21] Internal migration must contribute at least 50 percent of the growth experienced by urban areas, if urban and rural rates of natural increase are the same. If one considers realistically that urban natural increase in Africa is generally lower than the rural one, then the contribution of internal migration must be to the order of sixty to seventy percent, as suggested previously. In any event, what is clear is that the contribution of rural-urban migration to the growth of the cities in Africa is high. And that cities in Africa are growing at unprecedented high rates in comparison with those in other developing countries.[22]

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[20] The pattern is the expected one given the low level of development of the region, however. That is, at initial stages of development, when the urban percent is low, the urban population growth is due mostly to internal migration, whereas at higher stages of development, urban growth is due mostly to urban natural increase (Rogers, 1982; Rogers and Williamson, 1982).

[21] This is done by comparing the rates of urban growth with the rate of natural increase during 1960-1987. The comparison is only an approximation, given that the periods covered by the rate of natural increase and urban growth are not the same.

The above information suggests that the urban labour force is growing at extremely high rates, not far from the above seven percent rate of urban growth. This increase in the urban labour force has been absorbed mostly by falling urban real wages and expanding informal sectors in certain cases (Wanatabe, 1976; Gugler, 1988; Bloom and Freeman, 1987; Montgomery, 1985; Faruqee and Gulhati, 1983).

1.4.1 The Positive View of Internal Migration: Policy Guidelines

Rapid urbanization and internal migration have been interpreted under two perspectives in the development and population literature, an optimistic or neutral view and a pessimistic view. Even though there are differences of emphasis within each of these views, and both share some policy guidelines, this simplification is convenient to understand the array of policies which have been used to deal with rapid internal migration.

The optimistic view claims in essence that rapid internal migration entails the shift of unproductive labour from the country side toward the cities where it can be more productively employed. Thus, it enhances economic growth. This view associated formerly with Lewis (1954) and Ranis and Fei (1961), currently is also argued by neoclassical economists, e.g. Williamson (1988) and Adelman and Robinson (1978a, 1978b). In addition, internal migration is seen as performing an income redistribution function since urban earnings tend to be always higher than rural earnings (Adelman and Robinson, 1978a, 1978b; Yap, 1977). The swelling of informal services sectors (Mazumdar, 1976; 1977), apparently associated with rapid internal migration, is interpreted in terms of economic efficiency. That is, this sector is seen as performing a productive role provided it undertakes socially necessary activities for which the modern sector is ill equipped: e.g. recycling, repairs, construction of housing for the poor, and distribution. In addition, the sector is a learning sector for preparing incoming migrants to adapt to the cities (ILO, 1972; Sethuramam, 1976; Lubell, 1974; Schaefer, 1976). Thus, the policy guidelines are to encourage the informal sector rather than to harass it (Linn, 1983). Finally, shanty towns, whose growth is usually associated with rapid internal migration, are seen as a valuable investment by the poor and indeed the only realistic alternative for housing in the Third World. Thus, the policy is to upgrade shanty towns instead of destroying them (Linn, 1983).

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[22] For more information with respect to African migration patterns and urban characteristics, see Obudho (1979) and Adepoju (1988).

In sum, the neutral and optimistic view, seeks for policies tending to avoid artificial barriers to prevent internal migration. The view is not incompatible with the promotion of rural development. In fact, it shares with the negative view below, the conception that internal migration is enhanced by urban-rural inequality, and that the latter depends on urban biased policies. [23] As well, this approach would seek to erase minimum wages in cities.

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[23] Rural-urban inequality in Africa is worse than in most developing countries. In fact, non-agricultural incomes are in Africa four to nine times agricultural incomes. In the rest of the developing countries, these ratios are two to three at the most (Ghai and Radwan, 1983).

TABLE 1.6

URBANIZATION AND INTERNAL MIGRATION
1960-1987

Country	% Urban 1960	% Urban 1987	Nat. Increase Aver. 1965-80	Urban growth 60-70 rate	Urban growth 70-82 rate	Urban growth 80-87 rate
Zaire . . .	16	38	2.8	5.2	7.6	a
Kenya . . .	7	22	3.6	6.4	7.3	8.6
Sudan . . .	10	21	2.8	6.8	5.8	4.2
Nigeria . .	6	33	2.5	4.7	4.9	6.3
Ghana . . .	23	32	2.2	4.6	5	4.1
Tanzania . .	5	29	3.3	6.3	8.5	11.3
Zimbabwe . .	13	26	3.1	6.7	6	6.3
Ivory Coast	19	44	4.2	7.3	8.2	6.9
Average . .	12.4	30.6	3.06	6	6.7	6.8
Lower Middle Income . . .	24	34	2.5	4.4	4.4	3.5
Upper Middle Income . . .	45	63	2.1	4.4	3.9	3.2
Industrial economies .	68	78	0.9	1.9	1.3	0.9

a: information not available

Source World Bank Reports 1984-1989

University of Alberta

1.4.2 The Pessimist View of Internal Migration

The pessimist view of internal migration argues that rural-urban migration generate costs for the society which exceed the private gains accrued by the rural-urban migrants.[24] In rural areas, these costs are represented by poverty for those who are left behind: women, children and the old, and the loss of economic and social dynamism in whole regions drained of its most talented people. Finally, agricultural production might fall when it is badly needed. In urban areas, the social costs are represented by the creation of a redundant "street economy": prostitution, delinquency, and/or in the creation of surplus urban labour, even less productive than in agriculture. In addition, urbanization is expensive provided that governments have to create costly capital intensive and foreign exchange intensive modern services for the increasing urban population.[25]

There are other negative effects associated with rapid rural-urban migration. Poor Living conditions in shanty towns and low wages/incomes in informal sectors might lead to high mortality levels, even higher than in rural areas. Finally, there are clear risks of political upheaval associated with a "marginal" and demoralized urban population (Adepoju, 1988).

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[24] The pessimistic view was widely shared by Third World governments. In fact, a United Nations survey in 1977 found that 113 of 119 developing countries considered the distribution of their population unacceptable and many of them had taken measures to contain rural-urban migration. (Todaro and Stilkind, 1981)

[25] Todaro championed the anti-migration argument in a consistent theoretical work. See, for instance, Todaro (1969) for his basic and challenging model of internal migration; his arguments can be found in disperse papers; two good summaries are found in Todaro (1978) and Todaro (1980). For a complete analysis of the fast urbanization problem, see Todaro and Stilkind (1981), "City Bias and Rural Neglect: The Dilemma of Urban Development." The analysis of the of urban surplus case can be found in Mazumdar (1977), Sabot (1979) and Stiglitz (1981).

The most consistent policy guidelines of the negative view are to redress the rural-urban income inequality in order to reduce the migratory flow toward cities (Todaro, 1980). Several other policies which attack only the symptoms of the issue have been practiced in Africa. For instance, residence permits, appeals to go back to the land, eviction, and destruction of the shanty towns are reported by Adepoju (1988). Most of these policies, however, have failed. In short, these types of policies are increasingly seen as devices to disguise poverty within the country side and to prevent political unrest, indeed, perpetuating inequity (Simmons, 1977; Linn, 1983; Williamson, 1988).

2. Perspectives on Fertility Change and Modeling of the Demographic Transition

2.1 Interpretation of Fertility Change in Development: The contribution of Different Perspectives

The Demographic Transition Theory has been strongly criticized on two basic grounds. First, this theory is increasingly seen as inadequate in furthering an understanding of the demographic experience of developing countries. The fertility path of a number of less developed countries does not follow the stylized path as predicted by the theory. Second, it does not provide a framework sufficient to make or to design policies oriented to reduce fertility in those countries undergoing explosive rates of population growth (McNicoll, 1980, 1981, 1983; Frank and McNicoll, 1987).

The Demographic Transition Theory describes the eighteen century demographic experience of Europe as three sequential stages. In the first stage, both mortality and fertility are high; in the second, fertility remains high while mortality declines producing an explosive rate of population growth; and in the third one, fertility declines and thus population growth stabilizes at a low rate.

The causality[26] underlying this sequence of events is given by economic development, modernization and urbanization. In essence, economic development and associated improvements in the standard of living, the modernization in health technology and expansion of education lead to a reduction in mortality. The urban transformation reduces the economic value of children, while the reduction in infant mortality permits achieving the desired number of survivors with fewer births. In addition, the changes in cultural values produced by urbanization and education permit rationalizing the fact that children are no longer necessary assets, and thus these new values enhance fertility reduction. Modernization values are seen as having a role of their own which are independent of economic considerations. That is, they produce a shift in parental desires from large toward small family size. The ultimate cause in this shift is altruism which comes with modernization. Finally, it is assumed that parents must have access to techniques of fertility reduction. [27]

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[26] The term causality is herein used in the sense that the theory does. Precisely, one of the strongest criticism of this theory is that is not a theory at all but a descriptive device (Teitelbaum, 1976).

The theory of the demographic transition has been criticized on several grounds. Its predictive power has been seriously questioned, since not even the European decline in fertility on which the theory is based, conforms totally to the pattern claimed by the theory. That is, fertility declined in countries with sharply dissimilar urbanization and industrialization levels, and the lags between fertility and mortality decline also varied considerably among countries (Tilly, 1978; Greenhald, 1989).[28] The sequence of stages depicted by the theory is also in conflict with the empirical evidence. The data show modernization raises initially fertility in some Third World societies (Romaniuk, 1967, 1978; Bongaarts et al., 1984; Bongaarts, 1986; Morgan, 1976; Cantrelle et al., 1978; United Nations, 1987). Despite these criticisms,[29] the core of the demographic transition theory and its thesis that a low level of development produces high fertility while a high level of development produces low fertility remains by large unchallenged (Teitelbaum, 1976; McNicoll, 1981).

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[27] This depiction of the Demographic Transition Theory corresponds to its most generalized and gradually enriched version, associated to the work of several scholars. See Teitelbaum (1976).

The useful application of the demographic transition theory to the Third World, requires a framework that better incorporates the Third World context. In particular, it is crucial to define the notions of development, urbanization, modernization and their links to infant mortality reduction in this context. In addition, it is crucial to clarify how human beings translate the meaning of these categories to their lives and their reproductive decisions, and to establish what is the role of cultural factors in this translation. Finally, it is necessary to define the links between cultural and economic factors. Below, an attempt is made to clarify these elements.

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[28] For data and interpretation of the demographic transition in England, see Lee (1980) and Record (1962).

[29] For other criticisms of the Demographic Transition Theory see Schofield and Coleman (1986), McNicoll (1980), Caldwell (1976, 1977).

2.1.1 Why People Desire Large Families at Low Levels of Development

The parental conception of children at a low stage of development is strongly influenced by the asset (investment goods) characteristics of children.

In a rural sector, children constitute an investment in that they provide a source of cheap labour from an early age. In other words, the ability of peasants to secure income relies on the labour power at their disposal to undertake the agricultural tasks. Since, most peasants operate within a constrained income budget; they have to rely on family labour. Thus, the more children they have, the greater is the certainty and/or the expected magnitude of future income flows. As a peasant in northern India puts it: " A rich man has his machines; I have my children" (Conroy et al., 1981: 185). Finally, the empirical evidence strongly supports this hypothesis for explaining high fertility levels in low level developing countries (Repetto, 1976; Mueller, 1977; Macfarlane, 1978; Egero, 1980).

In the absence of formal social security systems, peasants and, in general, poor people, including urban workers, see children as their only sources of support for old age. The absence of children for a family, in a situation of uncertainty which is common in under-development, can become a matter of death and life. As a village woman puts it: "I have no son. If I give our girl in marriage to someone, who will protect us? What will happen when we grow old? (Djurfeldt and Lindberg, 1980: 110). Again, this hypothesis, the pension motive, is supported by the evidence (Epstein and Jackson, 1977; Mamdani, 1972; Lindert, 1980).

This basic economic argument is similar to Caldwell's view that high fertility in low level developing countries, is explained by a societal context which makes possible a flow of wealth from children to parents (Caldwell, 1976). This theory will be discussed at length later.

In short, the high fertility prevalent in low income and rural societies is explained in part by this asset characteristic of children. Increasing landlessness associated with development and population growth does not alter significantly the weight of these factors in determining high fertility. In fact, landless rural workers continue to derive economic benefits from children. (Djurfeldt and Lindberg, 1980). Nor does landlessness alter the pension motive, on the contrary it may enhance it (Mamdani, 1972).

2.1.2 Uncertainty, Fertility and The Insertion of the Peasantry in The World System

In analyzing the African economic-demographic context, it is crucial to provide at least a brief view of the historical meaning of the peasantry in relation to the rest of the economic organization.

The peasant economic organization currently existing in Africa is different from the one that existed prior to independence in the 1960s. In essence, the indigenous productive organization previous to the independence was communal and oriented to subsistence production. This economic organization entailed protection for the old, reserving some land which was cultivated communally with such a purpose. In addition, it entailed communal decisions regarding production, land allocation and income distribution (Ssennyonga, 1977). In comparison, the current economic organization is individualistic, oriented to profits and into a considerable extent oriented to cash-crops production.

This agricultural transformation according to several authoritative sources has enhanced the need for larger families. The reason is given by the fact that the immediate family becomes gradually the only form of economic security as communal protection bonds become erased (Epstein and Jackson, 1977).

Furthermore, several scholars have seen the transformation of peasants from food producers into cash-crop producers integrated into the world market, as another factor which has enhanced the uncertainty involved in agricultural activity (Egero, 1980; Weil, 1986; Greenhalgh, 1989).

The living conditions of cash-crop producers become determined by world price conditions for the staples which they produce: e.g cocoa, sisal, coffee, tea. The fluctuations in the prices of these staples have been extreme in the last twenty-thirty years. For instance, the Sahelian farmers, in the early eighties, who were encouraged by their governments acting on recommendations of the world lending institutions, to grow more cotton, faced in subsequent years a drop in cotton prices so severe that they were not even able to recover production costs (Pradervand, 1989). The price of sisal simply collapsed in the late seventies, causing the bankruptcy and poverty of thousands of Tanzanian farmers (Egero, 1980). In sum, the integration of these producers into a world system has led to increased uncertainty regarding incomes. Hence, the structure making high fertility a rational choice continues to be enhanced.

The process of capitalist agricultural transformation embodied in the process of economic development, produces winners and losers. Some of the peasants will succeed and become part of a prosperous rural bourgeoisie. In this case, the economic rationale for having large families will be reduced. Most of the peasants, however, will become landless, undergoing a period of increased poverty. In this case, it is fairly possible that their response to uncertainty will be one of maintenance of high fertility (Epstein and Jackson, 1977).

The proletarianization of the rural labour force, or increasing landlessness, is a typical and almost unavoidable phenomenon of development. It does not imply increasing poverty when the landless workers are absorbed in rural areas at equal or greater real wages than the income that they derived as farmers. This has happened in certain areas of Asia (Khan, 1988). Nor, does it mean poverty when the landless can be absorbed at equal or greater welfare levels in the cities. Nevertheless, given the pattern of economic development in Africa, landlessness means almost unavoidably increased poverty (Ghai and Radwan, 1983).

2.1.3 The First Effects of Modernization on African Fertility

The rationality for large families in a rural setting at a low stage of development, implies that peasants might desire as many children as possible. The constraint to obtain the desired number of children is mostly given by the poor health standard of mothers (Schultz, 1981; Bongaarts et al., 1984; Bongaarts, 1986).

Therefore, the outcome of higher fertility as a consequence of significant health improvements in certain African regions constitutes a logical outcome of the afore mentioned rationality. In Zaire, for instance, widespread sterility until the 1950s, was substantially reduced by the control of malaria and venereal diseases. The result of these measures was a sharp increase in the crude birth rate (Romaniuk; 1967, 1978). The result, indeed, helped peasants for whom infertility and sub-fertility constitute an economic disaster comparable to the loss of cattle and lack of rain (Ssennyonga, 1977).

There are still significant differences in fertility levels among rural regions within African countries. This suggests that there is a wide potential for modernization effects in raising fertility. On the other hand, it suggests that where fertility decline has taken place it is because of increased undernourishment (Bongaarts et al., 1984). In general, those regions better endowed with land quality, favourable climatic conditions, but mostly with a greater access to education and health tend to display significantly higher fertility levels than those regions with the opposite conditions (Anker and Knowles, 1982, 1983; Bongaarts et al., 1984).

It is important to emphasize that the rise of fertility, where it has taken place, has not been an unavoidable biological consequence of better health of mothers. It has also been driven by the rational societal desire for larger families. Indeed, parents could have counteracted the relaxation of the fecundity constraint by using traditional methods of fertility control. Bongaarts (1980), has argued that even the most primitive societies have had the capacity to control their fertility in response to economic-ecological circumstances. Nevertheless, in the case of Africa, parents have modified most of the, so called, proximate determinants of fertility to permit this to rise, e.g. reducing the post-partum sexual abstinence period and shortening the breast-feeding period (Handwerker, 1986; Bongaarts et al., 1984).[30] Certainly, it is difficult to disregard the hypothesis that these modifications might reflect partly the westernization of values.

Thus, African society may have been unwilling to control its fertility precisely because it desires high fertility. This interpretation agrees with most population literature on Africa (Frank and McNicoll, 1987; Egero, 1980; Hanwerker, 1986; Bongaarts et al., 1984).

2.1.4 The Elusive Connection Between Infant Mortality and Fertility in The African Context

The argument that because parents demand survivors, a decline in infant mortality is necessary for fertility to decline, needs to be qualified in the light of African evidence. This evidence shows that fertility might have even risen with the first health improvements (Faruqee and Gulhati, 1983; World Bank, 1980).

The seeming resilience of fertility to decline despite important improvements in infant mortality in Africa, has given support to diverse theoretical explanations of the high fertility African pattern.

One interpretation associated mainly with the World Bank, argues that the general inverse relation between development[31] and fertility does operate in Africa but at a slow pace (Faruqee and Gulhati, 1983; World Bank, 1980, 1984; Anker and Knowles, 1982, 1983). An explanation about the slow pace of the relation is not provided, except for the mention of African cultural factors, whose role is not further elaborated. Finally, it is argued that further reductions in infant mortality, more urbanization and higher income per head will anticipate the fertility decline (Frank and McNicoll, 1987).

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[30] Handwerker (1986), has showed how the fertility level of Liberian agriculturalists was a conscious desire for many children whose achievement was constrained by a range of biological and cultural factors.

[31] Infant mortality reduction in this approach is seen as an indicator of development.

The resilience of fertility has also generated multiple "ideal" theories of fertility. These theories claim essentially that African culture produces high fertility regardless of the level of economic development. For instance, Morgan (1976) has suggested that the "African cultural synthesis" produces high fertility, while the "Chinese cultural synthesis" produces low fertility. Religious values, e.g. the search for man immortality, polygamy, values enhancing virility, fecundity and thus the need for many children have been shown as proofs of these cultural elements (Caldwell, 1976; 1977; Mkangi, 1977; Ssennyonga, 1977). Later, we shall return to this point while discussing Caldwell's approach.

A third interpretation of the fertility resilience, suggests that the manner in which mortality has been reduced in low level developing countries does not constitute an indication of development. That is, the welfare of the majority of the population in Africa has varied little in the last twenty years. Specifically, neither nourishment levels nor clothing and shelter have improved for the majority (Ware, 1978; Ghai and Radwan, 1983). Thus, the decline in mortality has occurred basically because of exogenous measures, e.g. malaria eradication by the spraying of DDT and some increase in expenditure on curative medicine, rather than from improvements in the standard of living (Gaisie, 1979).

Hence, the decline in infant mortality registered in Africa, has not had the same basis in economic development that generated the endogenous infant mortality reduction in Europe. Thus, it probably does not have the same effect on fertility either (Teitelbaum, 1976).[32]

The developmental meaning that parents attach to infant mortality reduction in Africa, is possibly the one explained in the previous section. It is one in which a lower infant mortality permits individuals to attain the goal of desired larger families. And it does not manifest itself as a reduction in family size.

This does not imply that the reduction in infant mortality is unnecessary to achieve fertility reductions. The replacement mechanism or the positive relation between fertility and infant mortality will operate when development becomes a tangible reality for the majority of Africans. [33]

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[32] The fact that mortality decline in the Third World constitutes a totally exogenous imported product, which in general lines is correct, has been oversimplified. In fact, there is a limit beyond which better nourishment and general welfare are determinant in producing further gains in health and life expectancy. The importance of welfare measures directly related to the standard of living was indeed crucial in abating mortality e.g. in Sri Lanka and in China (United Nations, 1984).

In conclusion, it is argued that a rapid reduction in infant mortality without altering fundamentally the whole under-development reality of uncertainty, will not translate into a fertility decline. In the African situation, there may be no reduction in the demand for children when the supply constraint is eased. If this is so, the result cannot be anything other than an increase in fertility.

2.1.5 Does Urbanization Constitute Development in The African Context ?

The parental fertility decision at low levels of development entails a calculation of the expected benefits and costs of children. The expected benefits will outweigh the costs in particular in the predominantly rural stage of development. In principle, an inverse relation between fertility and development should obtain, provided that the expected net benefits of children tend to diminish along development (Lindert, 1980).

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[33] In this token, it is not surprising that the lag between the decline in infant mortality and the decline in fertility has been widening through time; the lag being much larger for Third World countries which have recently entered into a sustained path of development (Lindert, 1980). The main reason behind the widening of this lag would be the fact that medical technology advances have continued at a fast pace in the last twenty and thirty years, hence, the late-comers to development can experience a faster mortality decline than the early-comers. In a sense, development understood as an standard of living and cultural improvement, has become less necessary to produce the mortality decline to some extent, and life expectancy has become a less sensitive indicator of development.

The decline in the net benefits of children is heavily influenced by the process of urbanization. This is so, because urbanization leads to fewer sources of work for children, the cost of housing rises, women enter into the labour force in tasks incompatible with child rearing, and "modern" ideas become diffused (Birdsall, 1977).

The above familiar description embodies a view of urbanization proceeding rapidly and massively. Most importantly, this conception assumes that urbanization entails significant welfare gains for the urban population, and that it incorporates increasing segments of the population into a modern world of ideas. Indeed, this is the kernel of the role of urbanization in the demographic transition theory, and that is why urbanization is considered an index of modernization or development.

Nevertheless, urbanization in most of the Third World and particularly in Africa, presents very different characteristics from the stylized ones depicted above.

In the first place, urbanization does not mean the incorporation of an increasing segment of the population into a modern economy. The bulk of urban workers will be absorbed into the so called informal services sector with low and uncertain incomes rather than in the so called modern sectors. A non negligible percentage of urban women will be incorporated into the street economy: straightforward into prostitution, and children will have to sell their work. The living conditions in the shanty towns without water, electricity and sanitation can be hardly described as better than in the rural areas (Adepoju, 1988). Under these conditions it is difficult to equate urbanization with development (Menard and Moen, 1987). In short, urbanization in Africa can be seen most as a product of poverty and misery in the countryside rather than the product of a dynamic urban economy pulling rural people to the cities (Adepoju, 1988, Hoselitz, 1957). Thus, to see modernization and development in this form of urbanization is at least debatable.

Second, in Africa the rural-urban ties have not been really broken by urbanization. In fact, rural-urban migration is characterized by a high sex imbalance. Women and children often stay behind in the farm continuing to supply at least half of the family income (Anker and Knowles, 1983; Boserup, 1985). In these conditions, there is not a rise in the cost of children usually associated with urbanization. Nor the spread of modern ideas can be so easily associated with urbanization.

Third, the argument that the costs of children rise because there is not work for them in the cities, must be at least qualified in view of the existence of the informal sector and the "street economy" which does provide jobs for children in Third World cities (Mazumdar, 1976). Most importantly, in the context of urban poverty and lack of integration into a protected sector, children will continue to be considered possible investment assets (Mamdani, 1972).

Paraphrasing Egero (1980), the situation of peasants and urban wage workers is not that different, in the sense that both can only plan for their old age with the next generation i.e. children.

Possibly, one of the important negative effects of urbanization on fertility is given by the increasing cost of housing, in comparison to the countryside, which rises as urbanization proceeds. In addition, the incorporation of women into the urban labour force might constitute another important event precipitating a rise in the relative cost of children. Both events, however, are far from being immediate results of urbanization in the African context.

In conclusion, there are several reasons to think that the negative effects of urbanization on fertility are less severe or may proceed at a significantly slower pace than what is commonly expected from this kind of argument. Further, the negative effects of urbanization on fertility, do not depend as much on the quantity or level of urbanization, but on the quality or content of urbanization. That is, provided urbanization means the incorporation of increasing segments of the population into a modern world, with less uncertainty, better standard of living; and it means the incorporation of women into the modern labour force, with a commensurable rise in their status, then urbanization will be an important force in reducing fertility. But this type of urbanization is not what is taking place in Africa.

2.1.6 Institutional Change and Ideal Theories of Fertility: Can Ideas Trigger a Demographic Transition ?

The economic theory of fertility assumes that with economic development, the parental conception of children as assets changes gradually to one in which children are seen as goods (Becker, 1960, Birdsall et al., 1979). In sociological and anthropological terms, this means that children become desired for altruistic and love reasons, and/or parents cease to expect pecuniary benefits from them. Change in fertility tastes might have an important role in explaining fertility change. However, the lack of a theory of fertility tastes is the weakest element in all approaches to fertility (Donaldson, 1991).

Caldwell (1976, 1977) interprets high fertility in Africa as the result of a society whose cultural values permits the existence of a "flow of wealth" from children to parents.[34] He contends that fertility might remain high and lag behind economic development if the societal values supporting the flow of wealth from children to parents continue in place. He sees the "westernization" of values as a necessary condition to reverse the direction of the flow of wealth. This reversal, in turn, would be the key to produce the decline in fertility.

Specifically, Caldwell (1979) has argued that "westernization" might happen before economic development takes place through education, in particular, secondary education. There are few other policy guidelines in Caldwell's reformulation of demographic theory. Accelerated urbanization seems to be the only way besides secondary education in promoting to a certain extent the "westernization" of values. Urbanization would mean that an increasing fraction of the population, would be exposed more directly to the life style and values of the "west" or developed world, and the values supporting the extended family system would become weaker. [35]

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[34] The idea is based on conceptualizations of "modes of production", equating a peasant mode of production with high fertility and advanced capitalist modes of production with low fertility (Macfarlane, 1978).

Most sources agree in the key role performed by education and ideas in producing the decline in fertility. In fact, the negative effect of education on fertility has been seen along "value of time" arguments as raising the opportunity cost of children (Birdsall, 1977). But mostly, the negative effects of education on fertility arise because education expands the world of aspirations, status of women, and innovation, and ultimately gives people a greater degree of influence on their life chances (Freedman, 1979).

Freedman's (1982) perspective on fertility is representative of "ideal theories" which attach great importance to the role of ideas in changing fertility patterns. Specifically, he sees the "revolution in consumption and life style aspirations" generated by the exposure of the population to the consumption and life styles of urban elites, and/or to those of the developed world (demonstration effects) as an important factor in determining the reduction in fertility. The latter reduction would be necessary to satisfy at least in part the new higher material expectations of parents. Freedman (1982) views the partial validation of these higher consumption aspirations as a precondition for them to influence fertility. In this sense, his views are less idealist than those of Caldwell.

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[35] Caldwell's advocacy for the rapid erosion of the extended family system has been strongly criticized. Indeed, the extended family system performs an important role in providing minimum social benefits which the state because of the situation of under-development is unable to undertake. Ware (1978), has suggested that the societal implications of a total westernization of values in the absence of a level of economic development such as that of western advanced countries would be probably an increase of poverty and mortality, and even fertility as a defense mechanism.

Freedman (1978, 1982), analyzing the case of Indonesia, has pointed out that fertility started declining in rural areas despite conditions of widespread poverty and in the absence of social 'safety-net' policies. The decline started when the economy started to show signs of sustained and strong growth, even though the benefits of growth in the form of higher income per capita did not improve immediately the welfare of the majority. This hypothesis pointing to the expectations of greater future welfare, has been raised by several scholars in order to explain the demographic transitions in certain Asian countries, Korea and Taiwan (Tabah, 1990).

Freedman's (1982) perspective on demographic change, thus also points to a crucial role of urbanization in changing values promoting high fertility. Most importantly, he points to the role of expectations with respect to the future which can related to economic growth.

Certainly, the theories of fertility which attach a strong weight to "ideas" in determining the evolution of fertility, have been criticized because of their disregard of economic and/or socio-ecological conditions which determine it. Indeed, the empirical evidence tends to support the hypothesis that low fertility is equated with economic development and high fertility with under-development (Donaldson, 1991; Easterlin and Crimmins, 1985; Birdsall, 1977; McNicoll, 1981). More specifically, the African conception of children as assets reflects mostly the material reality of under-development. Hence, fertility is unlikely to decline until that basic changes (Ware, 1978; Epstein and Jackson, 1977; Lindert, 1980; Birdsall, 1981).[34]

It must be said in conclusion, however, that the role of cultural factors in determining fertility change cannot be ignored. Indeed, most of the demographic literature would agree that even in those patterns of urbanization characterized by widespread urban poverty, there is some modernization effect present of the type described by Caldwell (1976) and Freedman (1982). Nor can the role of expectations about the future wellbeing on fertility change be ignored as their effects are only now starting to be understood (Donaldson, 1991).

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[34] Most of the anthropological literature, indeed, has argued that cultural values in Africa constitute a rationalization for the need of greater families in view of the uncertainties of under-development (Greenhald, 1989). Epstein and Jackson (1977) collection of cross-cultural analyses of low level developed societies in Africa also argues this perspective.

2.2 Overall Strategies of Development and the Demographic Transition

2.2.1 Income-Equality Biased Strategies of Development: Their Possible Impact on Fertility

There are several cases of low level developing countries (LLDCs) and particular regions within LLDCs, in which fertility declined at relatively low levels of income per head and within a predominantly rural population. These are basically the cases of Sri Lanka (Fernando, 1976; Gunatilleke, 1982), Kerala in India (Ratcliffe, 1978; Nag, 1989), the Popular Republic of China (Parrish and Whyte, 1978) and Indonesia (Freedman, 1979). Other similar cases but less congenial to this analysis of LLDCs, given its relatively higher level of development are presented by Taiwan, South Korea (Rich, 1973); and Cuba (Diaz-Briquets and Perez, 1982). These experiences might be perhaps relevant in order to derive policies for accelerating the demographic transition in Sub Saharan Africa.

These cases have been denoted as "exceptions" to the conventional demographic transition theory in the population literature. Indeed, the levels of income per head, urbanization and industrialization of these countries when fertility starts declining, were far below levels which the demographic transition theory associates with a reduction in fertility (Berelson, 1978).

Most of the population literature attribute these "early" demographic transitions to the experience by these countries of improvements in key development variables, at an unusually low level of income per-capita. These variables were basically, life expectancy, education, food floors, and basic sort of social-security nets. Most of the literature as well agrees that these transitions occurred because of the bias of their governments in improving the welfare levels of the poor (Freedman, 1979; Gunatilleke, 1982).

Changes in values and rising aspirations, especially those related to the status of women, have also been seen as having an important role in explaining the fertility decline of these countries. Most of the literature, however, agrees that the rise in aspirations was trigered by the structural material change (Freedman, 1979).

Some studies, however, in particular referring to Indonesia, Korea and Taiwan, postulate that the decline in fertility started previously to any major social policies. They postulate, that fertility began to decline when these economies started growing strongly changing people's expectations with respect to the future (Tabah, 1989).

There is no still statistical proof of the causal mechanism producing the fertility decline. Indeed, paraphrasing Murdoch (1980: 72), there is no way to prove that socioeconomic policies have produced these early cases of fertility decline. Rich (1973), Kocher (1973) and Gunatilleke (1982) have attempted to demonstrate through descriptive comparative exercises across countries that income-equality biased strategies of development produced the early fertility decline. These exercises, however, have been criticized as anecdotical (Winegarden, 1985). Repetto (1979), Flegg (1979), and later several other scholars have statiscally proven the negative effect of a more equal income distribution on fertility, e.g. Wheeler (1980) and Winegarden (1985). This empirical work influenced by the evidence of the early demographic transitions, suggest indirectly the potential of basic needs policies in reducing fertility. Though, it is still uncertain that these studies have proven conclusively that strategies of development biased toward equality lead necessarily to a decline in fertility [37]

In addition, in particular in Africa, there are cases in which basic needs type of strategies have led probably even to a rise in fertility e.g. Tanzania (United Nations, 1989). Indeed, some scholars have raised the plausible hypothesis that basic needs policies will initially through an increase in nutrition raise fertility rather than reduce it. Finally, some stream of western economists argue that basic needs policies which imply strong state intervention in the market, reduce ultimately the rate of growth of the economy and thus jeopardize the very possibility for improving the standard of living of the poor. In this sense, basic need policies would retard the demographic transition.

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[37] See criticism by Winegarden (1985).

2.2.2 Strategies Emphasizing Economic Growth rather than Income Distribution: Possible Effects on the Demographic Transition

The classical view of the demographic transition assumed that "modernization" associated with urbanization, industrialization and level of income per capita close to those of the developed countries were a prerequisite for fertility decline. In this perspective, the level of income per capita epitomized "modernization", which was deemed crucial for producing the fertility decline. The policy guideline from this approach could be summarized as maximizing the rate of growth of income per capita in order to accelerate the demographic transition.

This view of the "modernization" role in leading to a decline in fertility underlies the frequently observed negative association between income per capita and fertility in cross-sectional studies using countries as the unit of observation. It is convenient to clarify certain aspects of this relation because it might be analytically misleading.

Methodological Issues

First, the predictive power of the relation is weak. For instance, a typical study (World Bank, 1980) based on a cross section of developing countries, in which the crude birth rate was estimated as a function of income per capita and its square, found extreme outlyers to the regression line, even though most countries approximated the predicted negative association. The exceptions were countries of high fertility and high levels of per capita income e.g. Mexico and Venezuela; and countries with low fertility given their low level of income per capita, e.g. Sri Lanka and Indonesia.

The presence of these exceptions to the negative relationship between income per capita and fertility has been rationalized in two ways (Birdsall, 1980: 12-18). The first has been a focus on the meaning of development itself. That is, fertility is seen as inversely related to "levels of literacy, life expectancy and the average incomes of the poorest half of the population" rather than to income per head". This would explain the relatively high fertility of Brazil, Venezuela and Mexico and the low one of Sri Lanka. The second interpretation argues that family planning, accelerated urbanization and "demonstration effects" explains the low fertility level of Indonesia (Freedman, 1979, 1982).

Second, in this negative association, income per head has no direct causal effect on fertility. [38] In this view, the negative cross-country association between income per-capita and fertility results from the fact that income per capita is a a proxy of the evolution of the so called determinants of fertility e.g. education, life expectancy, the wage rate and the female participation rate, and of changes in tastes. Variables, which in general tend to rise and/or change as income per capita raises. Their evolution in each country, however, might follow important deviations from the apparently uniform path described by the international cross section relation between income per head and fertility.

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[38] According, to the micro-economic literature the effect of income on fertility should be positive, proxying an income effect. This turns out to be generally the case in empirical studies when other factors accounting e.g. for the price of children are included in the regression (Birdsall, 1977).

For example, the relationship between income per capita and fertility in Kenya has been shown to be positive, or at the most quadratic in form, declining after a certain threshold of income. As reported in a World Bank analysis of Kenya demographic trends, improvements in health conditions are the main factors underlying fertility increases in Kenya during the seventies (World Bank, 1980: 20). Experience has shown that the initial impact of socioeconomic development is a reduction in sterility and an increase in the frequency of intercourse, both of which contribute to an increase in fertility

Simon (1974), has clarified these methodological issues by differentiating between short-medium term and long term effects of income on fertility. Short run effects are of the microeconomic type of effect raising in general fertility. This agrees with empirical findings e.g. of size of land in rural areas positively related to fertility, as well as the rural wage rate in Kenya (Anker and Knowles, 1982, 1983, 1985). In addition, in low development societies rising incomes increase nourishment levels in turn diminishing sub-fecundity and thus raising fertility. This finding is again consistently reported in the African development literature (World Bank, 1980).

Long term run effects, refer to the effects of income on raising education, life expectancy and urbanization, which in turn, tend to reduce fertility. As well, they refer to a moment where fertility starts being demand determined rather than supply determined (Easterlin and Crimmins, 1985), and thus raising wages can proxy value of time effects as well as education, which also has nonlinear effects of fertility in Africa (Anker and Knowles, 1982, 1983, Gomes, 1984, Boserup, 1985).

The Fertility Impact of Unbalanced Economic Growth

Once this methodological issue is clear, we can hypothesize two different and interactive ways in which economic development strategies emphasizing economic growth first and income distribution later can affect fertility

The first way relies mostly on the indirect effects that income per capita growth has on the determinants of fertility, and is relatively straightforward. That is, strong economic growth will have a strong effect on reducing fertility if it raises also strongly life expectancy, education, the female participation rate, the wage rate and urbanization. If the rural fertility response is perverse in the African sense, the task for economic growth in reducing fertility is more difficult.

There are several good reasons why in a dualistic economy with a sizable rural population there may be a very weak or lagged effects response on the conventional fertility determinants to economic growth. For instance, most benefits of growth may be retained only in urban areas and/or concentrated in some segment of the population. Then neither rural life expectancy nor rural education might improve greatly. Moreover, if there is a sizable portion of rural-surplus population the rural wage rate will not increase or may become stagnant. The problem, of course, is worse if rural fertility responds perversely.

In this case, strong economic growth reduces fertility mostly because it tends to produce strong rural-urban migration, and urban fertility is generally lower than rural fertility. This is very much the pattern of fertility decline of dualistic economies e.g. Brazil and Mexico, where urban fertility declines faster than rural fertility. The latter generally lagging for a considerable period of time (United Nations, 1988; Stern, 1984). Of course, strong economic economic growth has advantages over weak economic growth in that it might produce a faster motion of fertility decline.

The second way, however, constitutes an hypothetical possibility elaborated in light of the perspectives of fertility change of Caldwell (1977), Freedman (1978, 1982), Easterlin (1978) and Donaldson (1991). This states basically, that "fertility tastes" change might be a positive nonlinear function of urbanization, the rate of economic growth of income, and/or the same income per head. There are several hypotheses which have been advanced to suggest this link, "demonstration effects" and "revolution in aspirations". The most coherent and elaborated model in this vein corresponds to Donaldson (1991). Her model in essence postulates that "fertility tastes" change in function of the rate of economic growth. Most importantly, Donaldson's model has shown strong empirical power in explaining the demographic transitions of developing countries.

In this view of the role of economic growth, both the direct and the indirect effects of income on fertility would reinforce each other given more strength to the motion of change.

2.3 Competing Perspectives on Demographic Change and the Modeling of the Fertility-Development Nexus

The preceding discussion has highlighted the competing perspectives which exist in the literature regarding the link between socioeconomic development and fertility. The differing experiences of less developed countries suggest caution in attempting to choose a specific functional relationship to the exclusion of all others.

Different courses of fertility change in Sub-Saharan Africa, however, imply possibly important differences with respect to the evolution of socioeconomic development. That is, different courses of fertility evolution imply different courses of population growth which through several channels, e.g. internal migration and population pressure on the land, may produce different rates of growth of per capita income, income distribution and ultimately different levels of population welfare.

On the other hand, the evolution of fertility may depend strongly on the course of socioeconomic development. This interaction between fertility and development makes it essential that the appropriate specification of fertility be made if an exercise is undertaken to assess the impact of competing policies on the timing of the demographic transition. In other words, different specifications of the fertility response to socioeconomic development lead through different effects of population growth on socioeconomic development and hence to different courses of fertility decline.

It is very difficult to provide "the correct" specification of fertility for Africa. In view of this methodological issue, we use instead a variety of competing specifications of fertility when assessing both the capability of the model to replicate the stylized effects of development of the hypothetical African economy modeled, and in assessing the impact of competing development strategies on fertility change.

Two of the three fertility specifications used in the simulation exercise to follow, can be considered special cases of a common generic specification.

This common specification assumes that the urban crude birth rate declines nonlinearly as an index of development increases, until eventually reaching a low asymptote. It also assumes that the rural crude birth is a positive nonlinear function of life expectancy and food consumption before a threshold of development. At the right of this threshold, the rural crude birth rate declines nonlinearly as the index of development increases, until reaching eventually a low asymptote.

The two fertility specifications differ with respect to the index of development used.

The first specification uses as the index of development a cobb-douglas function of the real wage, life expectancy, a proxy for adult education and time giving account of change in tastes. The function is evaluated for rural and urban areas according to its corresponding variables (e.g. the rural index uses the rural wage, rural education and rural life expectancy). [39]

The second specification uses income per capita as the index of development. Thus, urban fertility is assumed to decline nonlinearly as income per capita rises. Rural fertility is assumed to vary positively with food consumption per capita and life expectancy until a threshold of income per capita is reached. At the right of the threshold, rural fertility is assumed to decline nonlinearly as income per capita rises.

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[39] It is worth recalling that in rural areas, the crude birth rate is evaluated as a positive function of life expectancy and food consumption per capita until development measured by the cobb-couglas index reaches a determined threshold.

A third fertility specification assumes simply that urban and rural fertility decline nonlinearly as income per head rises. The detailed discussion of these specifications is provided in chapter four.

The common assumption that urban and rural fertility (after the threshold) decline nonlinearly as development advances follows a widely accepted proposition in the population literature (Birdsall, 1977). The assumption of rural fertility rising at the first stages of development follows the Easterlin and Crimmins (1985) supply-demand synthesis of fertility determination at low levels of development. The assumption that only the rural population is below threshold levels in Africa, follows the World Bank population literature and empirical evidence from Africa (Birdsall, 1980).[40]

The two first alternative specifications do not represent extreme different perspectives on fertility change and under certain circumstances, they may have the same meaning. The third specification which disregards positive effects of development (modernization) on fertility may imply a dramatic different course of fertility change. Hence, these specifications differ essentially on the meaning of development and/or in the form in which development affects fertility.

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[40] Nonlinear and/or quadratic effects of most determinants of fertility are reported by most of the empirical studies of African fertility (Anker and Knowles, 1982, 1983; Anker, 1985; Gomes, 1984; Boserup, 1985; United Nations, 1987).

In the first specification, the cobb-douglas function weighing real wages, life expectancy and education can be seen somewhat as a measure of quality of life index, whose improvement is required to reduce fertility. It can also be seen in the conventional sense of the determinants of fertility literature e.g. the rise in the value of time (proxied by the real wage rate) reduces fertility. The specification also incorporates an accepted perspective of change in fertility tastes, postulating that tastes favouring large family size change more rapidly in urban than in rural areas (Freedman, 1979, 1982). Only the measurement of education as the educated proportion of the respective labour force (rural or urban) incorporates a structural flavour albeit realistic (Todaro, 1978, 1980).

In the second specification (which uses income per capita as the index of development) the decline of fertility is made more independent of the evolution of real wages, life expectancy, education and, in general, of rural-urban living standards differentials. Certainly, if change in per capita income presents a stable relation with the change in the latter variables, the underlying perspective of fertility change in this specification would differ little from the first specification. If this is not so, for several possible reasons, e.g stagnant real wages, the underlying perspective of fertility change in this specification is different.

In the latter case, the specification could be justified on grounds that growth in per capita income is the main signal viewed by both rural and urban reproductive agents in order to generate expectations of future welfare, and thus to reduce their fertility. The specification would follow as well the classic conception of the demographic transition stating that income per head summarizes "modernization" effects (Freedman, 1982; Donaldson, 1991).

In the third specification, fertility decline is also made more independent of real wages, life expectancy, education and rural-urban standard of living differentials. Most importantly, due to the disregard of positive effects of modernization on fertility, this specification implies a faster decline of fertility in relation to increases in income per head. The specification could be justified on the some grounds as those mentioned above (last paragraph).

These three specifications may imply very different path-times for fertility change. Hence, they also condition the effect of policies oriented to alter this time-path. For instance, a same rate of growth of income per capita has an obvious stronger effect on reducing fertility under fertility specification three, than under fertility specification one.

3. ECONOMIC DEMOGRAPHIC MODELING OF DEVELOPMENT: THE STATE OF THE ART

3.1 The Expansion of Modeling Towards A Comprehensive Approach to Population Issues

The state of the art in modeling the interplay of economic and demographic variables in development is assessed in this chapter. The purpose is to draw lessons from the most representative economic-demographic models of the last three decades, in order to model the Sub-Saharan African reality.

Population and development modeling constitutes a young but promising art in the assessment of the United Nations (1981) committee on population and development modeling. In a more harsh vein, a Fao assessment of the most known economic-demographic models, poses that most of them have naive economic conceptions and even technical errors (Sanderson, 1978). This situation is seen as true today also (Srinivasan, 1988:20).

Why is economic-demographic modeling still in such an embryonic state? Among several factors, one can point mostly at the lack of an adequate theoretical knowledge of the basic relations between population growth and economic development.

The lack of theoretical knowledge is clearly manifested in the assumptions underlying the first generation of economic-demographic models of the 1950s and 1960s. These models assumed basically that rapid population growth affected negatively economic growth, and that a reduction of fertility through birth control was necessary to promote development. In fact, the gradual attempt to improve upon these flawed theoretical conceptions is what essentially characterizes the evolution of development and population modeling.

The conception that population growth has a negative effect on economic growth, as seen in the first chapter, has been challenged on several grounds. What has emerged from this debate is a more complex view of this particular relation, and the whole relation between population and the economy. In general, the relations between population variables and the economy have been recognized to be multiple, reciprocal, and complex: e.g. they are often lagged and nonlinear (Schultz, 1981; Horlacher, 1981). Specifically, whether the effect of rapid population growth on economic growth is positive or negative, depends on the final balance of multiple other influences of population growth on the economy, and influences of the economy on population growth.[41]

Therefore, for models to be able to assess effects such as rapid population growth on economic growth, it is necessary to incorporate a more comprehensive array of reciprocal influences between population and the economy into their structures. In general, economic-demographic models have evolved toward better model-specifications capable of capturing the multiple, reciprocal and complex nature of the relations between population and the economy.

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[41] For instance, rapid population growth might raise the profits rate, accelerate internal migration, increase the rate of labour force participation, and alter demand patterns among other effects. These changes, in turn, might reduce and/or match the negative effects of population growth on economic growth which obtain from decreasing returns to labour.

Models have increasingly moved towards a comprehensive treatment of population related phenomena. They deal now simultaneously with internal migration, labour absorption, income distribution, demand, production, mortality and fertility, instead of being oriented to analyze these phenomena in a partial equilibrium context. The underlying theoretical principle in these models, is as suggested above, the total interdependence or multiple causality among economic and demographic variables. That is, none of the above phenomena could be analyzed, e.g. internal migration, independently from the whole system of economic-demographic relations.[42]

The conception that fertility can be considered an exogenous phenomenon that can be influenced without assessing its socioeconomic determinants, has pervaded population-development modeling. [43] There is widespread consensus in the demographic literature that fertility cannot be treated as exogenous (Frank and McNicoll, 1987). Early models which assumed that fertility was not altered by economic development while population growth affected negatively economic growth, incorporated a Malthusian conception of population (Conroy and Folbre, 1981).

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[42] On the other hand, the dealing of other population related phenomena, e.g. internal migration and underemployment by models, was also emphasized because they constituted more immediate policy concerns by themselves in relation to the elusive connection between population growth and economic growth.

[43] For instance, the Tempo were models "designed to illustrate the benefits of reduced fertility" (Horlacher, 1981, 46).

Economic-demographic models (ECODE) of development have moved towards improving upon the early conception of exogenous fertility, and to endogenize population growth. This change has been slow. Indeed, most of the ECODE, until recently specified population growth as exogenous; and most models which endogenize population growth still assume simplistic demographic specifications.[44] Finally, those few models which have attempted a more rigorous treatment of fertility and mortality, e.g. Bachue-Kenya, have faced the problem of uncertain demographic theory for low level developing societies (Anker and Knowles, 1983).

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[44] For instance, Coale and Hoover (1958) Tempo I and II, Ruprecht (1975), Adelman and Robinson (1978) and Swan et al. (1987) models treat population growth as exogenous. In general, they assume that the rate of population growth could be modified by government intervention in the form of family planning. The Kelley et al. (1972) and Mohan (1984) models also specify population growth as exogenous. The Kelley and Williamson (1984) model specifies the rate of population growth as depending on urbanization only, and it does not disaggregate by urban-rural areas, neither analyzes fertility nor mortality. The Fao model (1974), in one of its versions, endogenizes population; but it does not disaggregate by rural-urban areas. Finally, the Bachue models seem to constitute the exception with respect to a careful treatment of the demographic variables. The above list includes the majority of the current stock of economic-demographic models. (Sanderson, 1978; Horlacher, 1981; Ahlburg, 1987; Scott Moreland, 1981).

As an example of the extreme simplicity of the demographic specifications of most ECODE, one need only look to Kelley and Williamson's (1984) model of urbanization in the Third World. This model specifies population growth as inversely related to urbanization solely.[45] While, there is nothing intrinsically wrong in this specification for a very long term perspective, one can easily question its analytical and policy usefulness for assessing short and medium term phenomena. For instance, in an African context, it has been suggested that fertility in urban areas might be higher than in rural areas due to the greater concentration of health, at certain stages of development. For similar reasons, mortality might be lower in urban areas. Whether the rate of population growth in urban areas is higher or lower than in rural areas will depend of movements in the urban sex-ratio which changes according to the development process (Pool, 1971; Romaniuk, 1978; Bongaarts, 1986). Thus, it is fairly possible that an increase in urbanization, within certain range, might imply an increase rather than a decrease in the rate of population growth.[46]

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[45] According to authoritative sources (Ahlburg, 1987), this is one of the most promising economic-demographic models of development, albeit with an insufficient demographic specification.

[46] This does not constitute an attack to the demographic side of Kelley's and Williamson's (1984) model; indeed they are the first in recognizing the demographic insufficiency of their model.

3.2 Uncertain Theory, Demographic Time-Frame and the Speculative Realm of Economic-Demographic Modeling

The modeling of more comprehensive sets of economic-demographic relations, has required the knowledge of an increasing number of parameters. Unfortunately, there is no theoretical certainty about these parameters, nor its empirical estimation is possible in some instances.[47] Indeed, the deficiency of data in developing countries constitutes a serious obstacle to estimates of the parameters of a model. In addition, the common solution of estimating parameters through cross sectional studies might present serious methodological problems. Specifically, these estimates embody the risky assumption that static conditions are necessarily replicated in dynamic scenarios (Cole, 1977). This reality indicates why economic-demographic models of developing countries often proceed with informal guesses of the parameters rather than statiscally based estimates (Blandy, 1977; Bilsborrow, 1981).

Finally, economic-demographic models deal almost unavoidably with relatively long periods of time, because most demographic phenomena of interest entail long periods of time to operate. For instance, a complete rural-urban transition might involve approximately from fifty to seventy years (Fan and Day, 1978).[48] Thus, the time-frame of demographic phenomena compounds the degree of uncertainty and speculation embodied in population and development modeling (Blandy, 1977; Scott-Moreland, 1981).

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[47] Theoretical uncertainty can be illustrated by reference to the case of fertility in Africa, where education seems to affect fertility positively, and infant mortality to affect it negatively contrary to conventional expectations (Bilsborrow, 1981).

[48] Some scholars even postulate that the effects of

3.3 The Search for Realism in Population-Development Models

Finally, I would argue that economic-demographic modeling is moving in a direction of increasing socioeconomic and demographic realism. The lack of realism in many of the models has been an important factor in slowing the development of the discipline. I shall view this trend in the following areas.

A more complex view of the process of economic development has emerged. As discussed in chapter two, there is currently a differentiation between what constitutes economic growth, urbanization, modernization and the experience of development by the people. The experience of development is increasingly seen as the improvement in the quality of life and reduction of uncertainty by the majority of the people (Todaro, 1985). The demographic implications of this conceptual difference are vast, yet models are only recently incorporating this distinction.

Several factors in most economic demographic models have made it difficult to take this difference into account. For instance, models which do not analyze the functional

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••(cont'd) population growth on the economy will take periods above 100 years to operate. Specifically, Simon's (1976) model of developing countries which runs for 180 years, states that after 100 years, rapid population growth will have a favourable effect on the economy.

distribution of income, and do not consider relative price variations, especially of food, have limited demographic relevance. In general, they can hardly provide a demographic account different from one in which mortality and fertility decline uniformly through time, contrary to reality.

The reasons for the decline in fertility and mortality are not really provided by these models. In general, fertility and mortality are specified as negatively related to e.g. income per head and urbanization, which, in turn, can only grow, in a uniform way. Indeed, these models do not account for economic cycles nor are they theoretically prepared to analyze the demographic implications of these cycles.[49]

For similar reasons, these models cannot differentiate among several socioeconomic groups and sometimes among regions. Thus, they become almost useless for any relevant policy analysis of both fertility and mortality.[50]

Other factors, have also worked against the realism of the ECODE. In many instances these models have assumed "closed economies" isolated from world market conditions, contrary to the reality of most developing countries. While the assumption might be less damaging for India, it would be severely damaging in the African context. Indeed, the African economies have gone through periods of severe income fluctuations due to export instability. It is theoretically naive to assume that these fluctuations do not have demographic repercussions. A similar criticism can be raised with respect to models that do not consider external constraints to development, e.g. external indebtedness and exports restrictions.

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[49] To my knowledge, there is not any ECODE which analyzes the demographic repercussions for economic fluctuations in the vein of Easterlin's (1968) analysis for developed countries.

[50] In fact, these models would disregard the fact that poverty concentrates generally in rural areas, generating clearly a different mortality pattern than in urban areas (Mata, 1978; Khan, 1988). As well, they would disregard the fact that the urban population tends to get a disproportional greater share of the benefits of development (Todaro, 1985; Lipton, 1977; Bilsborrow, 1981).

Finally, one can summarize the trend toward realism in population and development modeling in the following aspects.

First, most models try to represent the essential economic and social features of developing countries by modeling them as dualistic societies. In essence, dualism entails a structural division of the economy in two sectors, one modern and one traditional, in which mostly institutional factors determine different behavioral economic rules. For example, in the modern sector wages are institutionally protected while in the traditional sector wages are determined competitively in urban areas, and by solidarity considerations in rural areas. [51] Modern sector producers have access to capital markets while traditional sector producers do not. In its social dimension, dualism is manifested in the concentration and favoring of the modern sector with respect to services provision (Lipton, 1977). Finally, social attitudes toward fertility and consumption might also differ along dualistic lines, e.g. between rural and urban areas (Kelley and Williamson, 1981).

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[51] That is, peasants distribute farm-income among themselves in equal shares.

Second, several recent models prefer to depict economic development as a transition between sequential disequilibrium stages rather than one between equilibrium stages. That is, e.g. profits rates among economic sectors do not equalize, internal migration is never sufficient to equate the expected urban wage with the rural wage as predicted by Todaro (Todaro, 1969; Adelman and Robinson, 1978). This reflects the outcome of low mobility of productive factors, and poor and asymmetric market information among economic agents. In essence, it recognizes that the process of economic development in the Third World is one characterized by severe imbalances (Kelley and Williamson, 1981; Adelman and Robinson, 1981; Friedman and Alonso, 1975; Dervis et al., 1982).

Finally, there is a stream in modeling which claims that social, technological, political and/or institutional factors constitute the most important determinants of the process of development, and hence should be incorporated into models. However, despite their importance, these factors have been generally disregarded by modelers, isolated as phases or exogenous phenomena which models cannot take into account (Cigno and Day, 1978; McNicoll, 1981; Arthur and McNicoll, 1975).

3.4 Basic Methodologies to Model The Population and Development Interaction

Before proceeding to the assessment of individual models, it is convenient to explain briefly some of the methodologies commonly used in models to integrate population growth into the economic specification. The assumptions embodied in these methodologies, have particular implications for the effects of population growth on economic growth, and the form in which the economy influences population growth. These assumptions, in turn, are contingent on both theoretical and practical issues specific to the time path of development. Thus, by knowing the core methodology underlying a model, one can grasp its core merits and flaws.

3.4.1 The Harrod-Domar Conception and Capital-Output Ratio Methodologies

Several of the earlier models attempting to show the negative effect of fast population growth on economic growth, were based on the Harrod-Domar model (Harrod, 1939; Domar, 1946). [52] This model determines the rate of growth of per-capita income as the quotient of the average propensity to save divided by the capital-output ratio, less the rate of growth of the population (Horlacher, 1981).[53]

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[52] Examples of models based upon this conception are Coale and Hoover (1958), Hoover and Perlman (1966) and Demeny (1965); more recent models partially based upon this conception are the Fao (Lin and Ottaviani-Carra, 1975) and Tempo (Enke, 1966; McFarland and Brown, 1973).

[53] The capital output ratio is simply defined as the ratio

In general, models based on this methodology also hypothesize aggregate savings to be negatively related with the rate of growth of population; and the capital-output ratio is hypothesized to be positively related with the latter rate. These relations obtain as follows. Higher fertility increases the dependency rate thus reducing savings (Leff, 1969; 1984). In addition, higher fertility implies that the proportion of the population that is of school age, becomes greater, determining a greater need for deviating otherwise productive investment resources to education. Thus, the capital-output ratio of this society becomes greater (Coale and Hoover, 1958).

Thus, what this model implies is that a greater rate of growth of the labour force without matching effects in terms of better capital efficiency (a lower capital-output ratio), and/or a higher rate of savings, will reduce the rate of income per head growth. Certainly, if in addition to this, a greater rate of population growth increases the capital-output ratio and reduces the savings rate, as explained above, its negative effect on economic growth is magnified.

Most of the assumptions of the Harrod-Domar model are currently considered inadequate to analyze the interaction between population and development (Sanderson, 1978; Ahlburg, 1987).

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[53] (cont'd) of the stock of capital and output or product, which remains constant unless technological progress reduces it. The average propensity to save is simply the fraction of output or product which is saved.

The assumption that the dependency rate has a negative effect on savings in developing countries, has been refuted by the empirical evidence. The theoretical explanation is that savings in developing countries originate mainly in the corporate sector rather than from households. Furthermore, due to the poverty of the majority of households, variations in the dependency rate are simply translated into variations in consumption per head. A higher dependency rate will mean a reduction in consumption per head and vice versa (Gupta; 1971, 1977, 1982; Mason, 1987; Bilsborrow, 1973, 1979). [54]

The assumption that education constitutes unproductive investment in developing countries, and that more educational expenditure would raise the capital-output ratio of the society has been contested by human capital theory. The argument, in simple terms, is that education should be considered as, or more, productive than physical capital (Todaro, 1985). [55]

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[54] The fact that variations in the dependency rate are matched by variations in consumption rather than savings in developing countries households eliminates also life-cycle considerations. The explanation of this is that savings might never obtain in the life cycle of the majority of families in developing countries, because of poverty. A more detailed discussion of the point, would have to clarify the meaning of households in developing countries in the light of the extended family system. Thus, it is fairly possible that household consumption is financed through both inter-generational and extended-family transfers. The point is not theoretically developed.

[55] An exception is constituted by the the Kelley, and Williamson's 1984 model. The "investment" character of education in developing countries is again under debate. The fact that most of unemployment in LDCs is constituted by educated labour has given support to this revisionist view (Blaug, 1987; Fields, 1971, 1974; Todaro, 1985).

Finally, the assumption that increases in labour do not add to production, unless capital increases in a similar rate, underestimates the contribution of labour to production, particularly in agrarian settings.

3.4.2 The Production Function Approach to Development: Supply Oriented Models

A production function with constant returns to scale and constant elasticity of substitution, for instance a Cobb-Douglas, predicts that output is a positive and nonlinear function of labour, capital, land and other natural resources, and the level of technology; that some degree of substitution between productive factors in production is possible. The marginal contribution of any productive factor will be a positive function of the reciprocal of the ratio of this factor to an aggregate of the other factors.

These properties make aggregate production functions a useful and simple device to analyze the sources of economic growth, and the contribution of population to it (Thirlwall, 1978). In brief, the possibility of substitution, implies that an increase in the labour force will increase total output even when all other productive factors remain constant, within a certain range. Specifically, the increase in the labour force at a greater rate than the ones at which the other factors are increasing, will imply a continuous decline in the marginal contribution of labour to production (marginal product) until it becomes zero or even negative. This decline can be halted or reversed if other factors grow at the same or greater rates than labour. Technological progress, by increasing the productivity of each factor can also halt or reverse the decline in the marginal product of labour, in the above case.[56]

The use of these production functions, as explained above, gives a more realistic role to labour than the one embodied in the Harrod-Domar model. It is one of the most important reasons why the use of this type of production function has become widespread in population and development modeling. The approach would seem particularly suited to Africa perhaps, where in certain cases strong economic growth was achieved through the extension of the land frontier and the use of abundant labour, in spite of little capital. The Ivory Coast case mentioned in chapter one, would approximate this situation.

What are the implications and shortcomings of this production function approach for the analysis of the interrelations between population and economic development? Herein, one must distinguish two situations. One corresponds to the shortcomings entailed by the use of these types of production functions, in general. The other corresponds to the use of a supply side view of economic growth disregarding the role of demand.

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[56] In the case of constant returns to scale, sum of the parameters equal to unity, the homogeneity property of this function, permits to specify output per capita as a positive function of the ratio of the aggregate of productive factors other than labour, to labour. This is an analytical useful property provided it permits a fairly simple analysis of the role of population growth on production per capita.

Constant returns to scale production functions, e.g. Cobb-Douglas, which assume that technological change and capital and/or land growth are independent of labour growth, imply by definition that a decrease in the rate of population growth will increase per capita income and vice versa. That is, the derivative of income per capita with respect to labour is negative (Sanderson, 1978: 6). It is worth noticing that the theoretical problem is not really with the production function itself but with the surrounding assumptions. Unfortunately, most of the models apply these production functions mechanically adopting these assumptions without assessing their implications.

Some models disregard the effects of demand forces on development. That is, they view economic growth as driven exclusively by the growth of labour, capital, natural resources and technological change. The policy implications of these models are obviously the ones suggested above. That is, a rapid rate of growth of population will probably lead to declining labour returns, and the solutions called for, are to reduce population growth, increase the savings rate and/or the rate of technological change. [57]

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[57] These ideas are more elegantly articulated in the Solow's model of economic growth (Solow, 1956). The Solow's model results however are not that different from the ones derived from a pedestrian analysis of an aggregated cobb-douglas production function. And they are subject to the same criticisms explained above. See Solow (1956), Swan (1956) and Leibenstein (1954) for an interesting demographic development of Solow's model.

The disregard of demand forces in these models, eliminates a possible channel through which demographic variations influence economic growth. For instance, rural-urban migration might shift tastes from food in favor of urban goods, stimulating their production. Provided that urban economy sectors experience higher rates of technological change than rural ones, and that rapid population growth determines rapid rural-urban migration; this would be a channel through which rapid population growth could influence positively economic growth compensating for the possible negative influence on production. Finally, the family size must have important demand effects which probably reinforce the production effects of population growth. For instance, a higher family size stimulates the consumption of food which has been associated to a decline in the rate of economic growth (Mohan, 1984; Kelley, 1969, 1974, 1979).

3.4.3 A Demand Approach to Development: the Input-Output Methodologies

An Input-output methodology [58] assumes that given the final national product and its distribution among private consumption, exports, investment, and government consumption, it is possible to solve for the requirements of intermediate production. In other words, the methodology assumes that the economy can be represented by a system of linear equations. The unknowns of the system are those amounts of sectoral production and imports consistent with the required net of intersectoral transactions required to produce the national income. The coefficients of the system represent the amount of input that one final unit of product of one sector, requires from another sector. These coefficients are assumed to remain fixed on time. Employment requirements per productive sector could also be represented in this manner. In sum, the input-output methodology is basically a planning method oriented to analyze intermediate production, manpower and other intermediate requirements compatible with a final target of income. [59]

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[58] The Input-output methodology was developed by Wassily Leontieff (1951).

How does population enter into the input-output methodology? Population variables are generally used as determinants of final sectoral consumption, in addition to other economic variables. For example, private consumption of food, construction and manufactures are specified as function of demographic variables, e.g. of total population or number of equivalent adult consumers, besides income. Demographic variables, can also be used to affect the final composition of national income in other ways. For instance, a greater school population could imply a greater government expenditure in education, and consequent reductions in investment and/or in consumption, in order to finance the relative expansion in education expenditure. Finally, the sectoral distribution of consumption also determines the pattern of sectoral production growth. That, is an increase in the consumption of manufactures relative to the one in food will also imply a relative expansion of the manufactures sector.[60]

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[59] A more rigorous explanation of the Input-Output methodology would take us far aside from the point in discussion. The interested reader should consult Taylor (1979).

What are the main theoretical problems of this methodology? Mostly, they are related to the fact that economic growth cannot be clearly linked to the supply of productive factors. Thus, neither growth in the labour force, nor in capital, or in any other productive factor actually determines the growth of output. The model results are exclusively driven by demand. This would mean, for instance, that neither a reduction nor an increase in the rate of population growth would affect the rate of output growth. Nor that changes in the spatial distribution of the population would affect it. In short, the link of population affecting output is eliminated from the analysis of the population relation with the economy (Bilsborrow, 1981).

There is some room in the methodology, for improvements on this limitation. For instance, supply constrains in terms of maximum agricultural production, and constraints in the amount of disposable foreign exchange, and exports can be introduced. This improves the modeling provided output becomes endogenous, and it can be related to the effects of population, e.g. as it is done in Bachue-Kenya.

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[60] That is, it assumes perfect elasticity of supply of capital and labour.

There are other problems with the methodology that are less severe. For instance, sectoral employment is determined after output. In doing this, this type of model has to resort to elements exogenous to it. Relative prices variations are difficult to incorporate.

In sum, the input-output methodology might constitute a reasonable alternative when data are too faulty to employ production functions in the supply side of the economic-demographic interaction (Anker and Knowles, 1983).

3.4.4 General Equilibrium Models

The last type of general methodology to assess the core relations between population and the economy are general equilibrium models.

A complete description of this methodology goes beyond the scope of the present discussion.[61] In the context of population and development modeling, the general equilibrium model is a valuable methodology in that it makes it possible to capture both the supply and demand forces affecting development. Thus, the most important avenues through which population influences the economy are captured.

Most importantly, the general equilibrium model provides a set of theoretical propositions corresponding to ideal type conditions, which, provides a pattern to analyze departures from these conditions. Thus, one can incorporate

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[61] See Dervis et al. (1982) for a detailed explanation of the application of general equilibrium models to analyze development.

the features of the functioning of Third World economies, e.g. lack of competitiveness and dualist or segmented markets, which depart from these ideal conditions, but still have a reasonable theoretical framework for understanding the causality behind the model results (Dervis et al., 1982).

Nevertheless, a well known general equilibrium theory does not override the requirement of performing adequate modifications on the general equilibrium framework in order to represent the population-development interaction. Indeed, modeling these phenomena constitutes, to a great extent, an art rather than a technique (Wery et al., 1977; Rodgers et al., 1977; Horlacher, 1981).

3.4.5 A Note on the Endogenization of Population

The reviewed methodologies deal with the basic effects of population growth and change in age-structure on the economy. In order to analyze the effects of the economy on the population, these methodologies have to add a pure demographic submodel wherein mortality and fertility become endogenous in the economy. Any model which does not capture both sides of the relation between the economy and population will give a biased analysis of population related phenomena.

3.5 Final Overview of Economic-Demographic Models

There are thousands of models of economic development in which population, however, is not a main concern. Those types of models are thus excluded from this review. For instance, the models associated with the work of Lance Taylor (1979),[62] are particularly insightful in capturing the characteristics of developing countries economies, however, these models are not oriented to deal with population issues.

As well, there are thousands of statistical models which attempt to measure or explain the impact of several socioeconomic variables on demographic variables. Yet, these models do not simulate economic-demographic interactions in a dynamic temporal framework. This was another criterion of exclusion.

It must be said that there are some important omissions from this review due to space and/or other type of reasons. For instance, Bachue-International (Moreland, 1978) is not reviewed because it was thought that the review of two other models of the Bachue series with similar methodology would suffice to discuss such type of modeling. Unfortunately, a recent fairly comprehensive economic-demographic model of Kenya associated with the work of Neil Swan and a team of Canadian and Kenyan economists and demographers (Swan et al, 1987) is not reviewed. The reason for its omission was that only a partial version of such model and its results were available for this research, hence, a proper discussion of it was difficult. Some of the ideas expressed in the available version of such model, however, were influential into the model designed in this research.[63]

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[62] See also "Models of Growth and Development for Brazil" in Taylor et. al. (1980).

Finally, the order in which the models are presented corresponds roughly with our view of the direction in which economic-demographic has evolved. The order is only approximately chronological.

3.5.1 The Early Conception: The TEMPO Models

The Tempo models based on a theoretical framework devised by Stephen Enke (1966),[64] were oriented to demonstrate the benefits associated with reduced fertility in developing countries (Horlacher, 1981).

Tempo I, is constituted only by one economic sector represented by an aggregate Cobb-Douglas production function and a demographic submodel which projects exogenously the population by age and sex. The interaction of population and development is given only by the effect of an increased labour force on production. There are no feedback effects from the economics variables to population. Because of the extreme and crude simplicity of Tempo-I, only Tempo-II will be discussed.

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[63] The model was unpublished and this author had access only to a draft of the core model. Not until much later, it was possible to have access to part of the demographic submodel which constituted basically a set of exogenously driven population projections.

[64] These models were developed by the Tempo research center of the General Electric Company. Its final implementation is associated to William McFarland, James Benett and Richard Brown (1973).

Tempo II, was disaggregated by rural and urban areas, specifying a modern urban sector and a subsistence rural sector and incorporated the analysis of internal migration. In addition, a public sector whose services sector affected the demographic variables was incorporated.

The government provides education in Tempo-II, according to sex-specific and age enrollment targets which can be altered exogenously. The cost of education is, however, assumed to remain constant a point that can be debated.[65]

Fertility was specified as a negative function of government expenditure on family planning, and mortality was specified as a negative function of health expenditure. Both were treated as linear functions. The economic variables did not affect the demographic variables except for migration.

Production in the agricultural sector is assumed to use only labour, neither capital nor technological change is allowed. The production function is a Cobb-Douglas function. The labor force, equal to the total population, entering into the production function is lagged one year[66] Production in the modern sector, is represented by a Cobb-Douglas function which uses capital, educated and uneducated labour; all lagged one period. The function incorporates a constant rate of technological change. There are no intermediate inputs.

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[65] An interesting feature of the Tempo model is that incorporates inflation; that is, the government can cover its deficit just by printing money.

[66] This was done with the purpose of avoiding simultaneity with migration.

Disposable income is the aggregate of the modern sector product plus the rural sector product less taxes. The factor distribution of income is not obtained. Savings are postulated as a positive function of disposable per-capita income as well as consumption.

Finally, internal migration is specified as a positive function of the ratio of the physical average product per worker in the urban to the rural areas.

The Assessment of TEMPO

What The Tempo model attempts to show is that population growth in developing countries negatively affects economic growth.

In short, it demonstrates a negative relationship between economic growth and population because of the mechanical application of a Cobb-Douglas production function.

Specifically, population growth does not affect positively the amount of arable land, nor does it shift cultivation systems toward multi-cropping, which might represent technological change in an agrarian context. In fact, land is not included in the model or is implicitly fixed. Nor can peasants create capital with their work, e.g. channels. Thus, in an economy presumably mostly agrarian, under these conditions, the marginal product of labour cannot but decline rapidly all along the simulation period.

A very different account obtains from a reading of economic growth in the Ivory Coast, for instance.

Internal migration to the cities proceeds rapidly producing a decline in the rural-urban labour productivity differential, and pressing down the urban real wage. Since, the income distribution does not operate in the model, the fall in the urban real wage does not translate into an increase in the profits rate, nor in greater investment. Both effects which would counteract the negative effect of rapid population growth on economic growth. The fall in the marginal product of labour translates into a rapid reduction of savings which are not specified to depend on the income distribution, thus, pressing further down the rate of growth of income per head.

Finally, the growth of population is exaggerated in the basic simulation conditions of Tempo. Indeed, fertility does not depend on any index of development nor on education, thus, it is kept constant. On the other hand, the decline of mortality is exaggerated in conditions that the expansion of governmental health care is costless. This compounds the depressing economic forces in motion in Tempo.

In sum, Tempo is an extremely simplistic Malthusian model. Nonetheless, more recent models, in spite of greater refinements and elegance, are not really much different from this basic Malthusian conception of population. It does not make sense to comment upon the details of Tempo, though it contains many technical problems (Sanderson, 1978). For instance, rural-urban migration will not be brought to an halt until the average product per-worker in the city has become zero, failing to consider that the urban worker's real income has fallen below the one of the rural worker.

3.5.2 The Early Conception: The Fao Model

The objective of the Fao economic-demographic model was "to provide a systems model capable of simulating population dynamics, economic development and economic-demographic interaction, with special reference to the agricultural sector." [67]. The Fao model has been applied to Egypt and Pakistan.

Production is disaggregated into two basic sectors, agriculture and the urban sector. Agriculture is in turn subdivided into small scale farming in rainfed regions, large scale farming in rainfed regions, small scale farming in irrigated regions and large scale farming into irrigated regions. The urban sector is disaggregated into small scale industry, large scale industry, capital goods industry, construction, traditional services, modern services and government services.

Agricultural production in the different agricultural sub-sectors is specified as a linear function of yield per acre in the previous period, net investment in the previous period, the amount of land used and the quantity of inputs used in the current period.

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[67] It is described by Martos (1978, 1).

There is not any role for labour, thus for population on production, in the thirty years of the simulation. As well, there is no role for different skills or manpower formation within the agricultural labour force. It is implicitly assumed that the marginal contribution of labour is zero.

The Fao model assumes that all relative prices remain constant; in this sense the use of policies affecting relative prices have no effect on either agricultural production, or on industrial production. As well, similar to the Tempo model, the analysis of internal migration in Fao is defective.

Urban sector production in period t, depends upon net-output in the period t-1 plus the product of an exogenous amount of net investment and a fixed incremental capital-output ratio. The drawbacks of this formulation were discussed previously when analyzing the Harrod Domar model. In short, a productive role for the labour force is precluded. Technological change is, however, considered in the Fao model.

The fact that investment is exogenous for all sectors suppresses the link that population variables might have through demand, upon the profit rates of the different economic sectors.

The demand side of the Fao model excludes prices. As well, provided that there are not payments to productive factors, it is not possible to link changes in the income distribution to demand. This, as was explained for the Tempo model, suppresses important mechanisms for population variables to feedback into the economy.

The Role of Population in the Fao Model

Private consumption is equal to the number of adult equivalent consumers times per capita consumption. The number of equivalent consumers is equal to the sum of the total population weighted by the nutritional requirements of the different age-sex groups. Per capita consumption equals per-capita consumption in the previous period times an "exogenous" growth rate. Government consumption grows proportionally to government investment in health and education, thus ultimately as a function of population growth. Investment, decided by the government, equals gross domestic production plus imports less consumption and exports.

In short, population growth through increased consumption, and forcing the government towards an increase in education and health expenditure, diminishes the resources available for investment. It is worth emphasizing that population increase has only effects on consumption but not on production.

The Demographic Component of the Fao Model

There are two demographic specifications of the Fao model, one projects population exogenously, the one used in Pakistan (Sanderson, 1978); a second version reviewed here endogenizes population. In both specifications, population is projected by age/sex and rural/urban residence.

The total fertility rate is assumed to depend on the educational level of adults and on the amount of employment available for women in the modern sector. The level of adult education in turn, is mostly influenced by an exogenous population policy multiplier, whose alteration is costless. This specification, thus, precludes a realistic assessment of the benefits of providing more education. The availability of female employment in the modern sector is postulated to be a negative function of the difference between the rate of creation of modern jobs less the rate of growth of the number of females in the reproductive age category. Life expectancy is postulated as a positive function of per capita consumption and government service investment.

In sum, the demographic specification in the Fao model is a small step in the right direction, although as a whole, it is a weak formulation.

Employment and Income Distribution

Employment in the modern sector, is determined by using employment-output ratios; obviously employment growth through time depends on the amount of investment. Unemployment is defined as the difference between modern sector employment and the modern labour force. The modern labour force is defined in the base year according to survey information, thus the modern labour force is a subset of the urban labour force. It grows through time, according to transfers between other sectors, and by a rate of natural increase equal to that of the aggregate labour force.

The output employment ratios are allowed to change on time depending upon previous rates of change in unemployment; according to Sanderson (1978, 121), however, it is not clear how the simulation arrives to the prediction of increasing rates of unemployment in the modern sector. In the traditional sectors, zero unemployment is assumed.

Certainly, this manner of obtaining employment and unemployment is fraught with problems. This model does not provide an analytical picture of the functioning of labour markets in developing countries. In a sense, the unemployment results are quasi-definitional or the assumptions lead directly to the results. Even with poor data, a context of neoclassical production functions, wherein different assumptions with respect to the labour market functioning can be incorporated, would provide a more insightful analysis of the relations between population pressure and employment.

The participation rates by sex and age are kept constant in the Fao model. Thus, the aggregate labour force grows in line with the rate of growth of the total population; a common assumption of economic-demographic models. Sanderson (1978), questions this assumption arguing that the participation rate might vary with development. Actually the constant assumption is not that unrealistic for the case of developing countries; in particular, this is true for the low level developing countries where the participation rate tend to vary very slowly.

Internal Migration

Internal migration in the Fao model is a function of the ratio of physical labour productivities in the modern and the traditional sectors, and of a gravity multiplier. The relation between the marginal productivities has the usual role, of reflecting a differential in labour productivity in favor of the modern sector thus pulling labour from the country side. The gravity multiplier fulfills the role of increasing the migration rate, when the level of urbanization is low and to diminish this rate, when the level of urbanization is high. The use of the gravity multiplier, in a sense, represents a failure of theory, as it replaces precisely what should be explained by elements of the model. These elements are mostly the role of non-tradables, rural-urban cost of living differentials, probabilities of modern sector employment and rural-urban terms of trade.

3.5.3 Demand Driven Models: Bachue Philippines and Kenya

The Bachue series of models were developed by the World Employment Programme of the International Labour Organization (ILO), in order to analyze the interactions between population, employment and inequality. There are several Bachue-models but all share a similar analytical conception emphasizing the use of input-output methodologies.[68]

3.5.4 Bachue Philippines

Bachue Philippines, is a recursive demand model oriented to analyze the interactions between demographic variables, employment and income distribution in a dualistic economy. The model uses an input-output methodology wherein the dynamic projection of a final demand vector is used to drive the economy. The economic results affect the demographic variables which feedback recursively into the economic subsystem.

Their authors justify the choice of "demand" as the main factor in driving the model results arguing that the effects of population growth on employment and income distribution come mainly from the effects of population growth on demand. (Hopkins et al., 1976; Wery et al., 1977).

The extreme emphasis on demand in this model, has been strongly criticized (Ahlburg, 1987). Specifically, Sanderson (1978) has argued that Bachue-Philippines major problem is that neither labour nor capital, except for the agricultural sector, affects output. Therefore, the effects of population growth and rural-urban migration on employment and income distribution and their feedbacks, are analyzed in a framework in which total output is invariant with respect to variations in the rate of population growth and its spatial distribution (Sanderson, 1978; Ahlburg, 1987).

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[68] Some of the Bachue-models are, Bachue-Philippines constructed by Rodgers, Wery and Hopkins (1978); Bachue-Brazil designed by Burle de Figuereido and Rato (1977); Bachue-Yugoeslavia constructed by Macura, Popovic and Rasevic (1977); Bachue-International, developed by Moreland (1978) and Bachue-Kenya designed by Anker and Knowles (1983). All of them share common methodological features.

The supply restrictions, which the model incorporates to provide more realism, are extremely debatable. They include the assumption that GDP and investment grow at an exogenous rate of seven percent annual rate. These supply restrictions imply that changes in the composition of demand, while altering sectoral rates of growth, must adjust to the given total rate of growth of the economy.

The modelers defend the structure of their demand-driven model, and its supply restrictions, arguing that the model results are realistic. In particular, they argue that the trade balance does not deteriorate during the period of the simulation, as it might be expected in a situation without supply restrictions. Indeed, in the basic simulation run, the trade balance remains in surplus for the whole analyzed period. In addition, they argue that alternative assumptions of rates of growth, of 8 and 9 percent in GDP and investment would produce instead unmanageable explosive trade deficits for the economy (Wery et al., 1976, 90).

This defense, however, does not address the substantive issues, that neither the rate of growth of population nor its distribution affect production and capital formation. In addition, it says nothing about the fact that the income distribution does not affect capital formation. Moreover the level of savings regardless of the link to population, have no effect on investment. Finally, the only role of population is to affect consumption, provided an increase in per-capita income, consistent with the model, but which is inconsistent with reality. In addition, the type of uniform growth of income depicted by the model is also highly unrealistic.

In conclusion, this model might be considered basically as a planning model, wherein only "partial effects" of population variables upon employment and income distribution can be analyzed; and important links between population and development are methodologically disregarded. It is more analytically useful to review Bachue-Kenya which does a more ingenious use of the Input-Output methodology.

3.5.5 Bachue-Kenya

Bachue-Kenya, is the most recent model developed by ILO in cooperation with the United Nations Funds for Population Activities (UNFPA). ‘’

The model depicts a dualistic economy constituted by ten sectors, with formal and informal components; the demographic submodel presents the same degree of disaggregation as Bachue-Philippines. This model shares some of the basic methodological principles with Bachue-Philippines, embodied in the use of an Input-Output methodology. But, the supply restrictions are incorporated

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‘’Its authors are Richard Anker and James C. Knowles. The model-results were published in 1983.

in a more meaningful way, permitting economic growth to be endogenous, and thus to capture to an important extent the role of supply forces. The demographic treatment, as well, is noticeably superior to the one in Bachue-Philippines. It permits a robust demographic specification of the disaggregated rural-urban behavior. Finally, the treatment of prices is perhaps weaker than in Bachue-Philippines. In Bachue-Kenya all relative prices are assumed to remain constant for the whole simulation analysis.

The Core Behavior of Bachue Kenya and the Role of Population

The core behavior of Bachue-Kenya can be understood by the role of the two supply constraints imposed into the behavior of the economy; a "foreign exchange constraint" given by the availability of foreign currency to import goods, and a "domestic constraint" represented by the equality between agricultural domestic production and its demand. [70]

The "foreign exchange constraint" depends upon the magnitude of exports, whose demand is exogenous, and the magnitude of a limited foreign capital inflow in each period. In short, imports must adjust to this "capacity to import" of the economy.

The "domestic constraint" implies that the demand for agricultural goods must adjust to its supply for each period. The supply of agricultural goods was captured by using a Cobb-Douglas production function which includes labour, land, capital and technological change among its arguments.

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[70] This constitutes the main modification with respect to Bachue-Philippines.

The interaction of the above two constraints and the general behavior of the economy operates as follows. Given a final vector of demand constituted by exogenous investment, exports, government consumption and private consumption for each period, the application of the input-output methodology yields an initial estimation of sectoral demands, intermediate imports [71] and sectoral production.

The consistency of these results with the above constraints is then reviewed. The foreign constraint is reviewed first. If imports are greater (lower) than the capacity to import, then all the elements of the final demand vector excepting exports are reduced (increased) in a proportional manner. With this new final demand vector, a new round of sectoral demands is obtained and the consistency of this new solution is checked again in relation to the foreign constraint. The procedure is repeated until the balance of trade registers a deficit between 9 to 11 percent of exports. [72]

Next, the domestic constraint is reviewed; if demand for agriculture products exceeds (falls short of) supply, agricultural exports are reduced (increased) until the equality supply-demand is restored. The review of the domestic constraint alters the foreign exchange constraint which requires a new round of revisions of both constraints until both are finally satisfied.[73]

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[71] Each sectoral demand is equal to sectoral value added; value added in turn obtains as a fixed proportion of gross output. The solution for gross outputs permit to obtain intermediate inputs. Final imports constitute a fixed proportion of final consumption and investment.

[72] Anker and Knowles, 1983: 352; see foot note No8.

The procedure of adjusting the economy to its constraints, means that the rate of growth of the economy is endogenous upon these constraints. That is, if the amount of initial imports is higher than that allowed by the initial foreign exchange constraint; then, the size of GDP, and thus, the rate of growth of the economy, has to be reduced in order to reduce imports. By the same token if initial exports are higher than imports, the economy can grow at a higher rate. The domestic constraint fulfills a similar role provided it is directly connected with the foreign constraint. That is, if the initial demand for agricultural goods is higher than its supply, then, the consequent reduction in exports implies a reduction in the rate of economic growth.

The model captures Kenya's reality of being a net exporter of agricultural goods, and emphasizes the crucial importance of the agricultural sector in shifting dynamically the "foreign constraint". That is, given an exogenously limited capital inflow, in an economy in which all its sectors e.g. require imports for their expansion, and part of final consumption is constituted by imports; then the expansion of the economy depends crucially on the expansion of its exportable surplus; in this case the agricultural surplus.

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[73] There is some question why this procedure was not attempted simultaneously rather than recursively.

The role of population in affecting economic growth in the model is straightforward. Population growth affects both agricultural production and consumption. It "net" effect in economic growth then, will depend basically upon the the balance of these two effects. It must be emphasized, that urban population has no direct effect upon production in this model. It operates through demand. However, urban population does affect consumption. Thus, rural-urban migration reduces economic growth and retention of population on the land increases economic growth. Effectively, the model emphasizes urban surplus rather than rural surplus population.

Agricultural production, is represented by two Cobb-Douglas production functions corresponding to small and big farms, using capital, labour, land and technological change as arguments. Technological change in small farms is endogenized with respect to farmers education; in big farms, it is assumed to be exogenous.

The Demographic Side of Bachue-Kenya

In the demographic side of the model, rural-urban migration is specified as a positive function of urban-rural wage differentials, urban-rural income differentials and employment prospects in the modern sector. A scheme of migration by age, sex and education was estimated and used to distribute the overall migration rate among the age-sex-educational brackets.

Fertility was measured by the number of live births. In the rural areas, it was postulated that fertility varies inversely with two levels of woman's education, primary school and secondary school, and positively with household income and infant mortality. Fertility is also postulated to be affected by residence per se, rural or urban. Rural residence has a positive impact on fertility.

In urban areas, fertility was postulated to be positively affected by primary school and negatively by the secondary school educational level of women, and to be positively affected by infant mortality. It was also assumed a higher fertility rate for women who immigrated to the cities from the country side, than for the urban born. Finally, urban residence has a mild negative effect on fertility.

Mortality, measured by the probability of a birth surviving to age 3, was postulated as a positive function of woman's education, income per equivalent consumer, and as a negative function of the degree of income inequality. Residence also affects mortality. The effect of being urban increases the probability of a birth surviving to age 3. Finally, technological medical change shifting upward periodically the survival function by a certain rate was also added to the specification.

The specification of fertility and mortality corresponds to a careful theoretical treatment too long to be reproduced here (Anker and Knowles, 1983: 30-88).[74] It suffices to say that it reflects accurately Kenyan reality. For instance, there are not magic fertility planning programs, and the differentiation of the effects of mother's education on fertility by rural-urban setting is commendable. Above all, the authors refrain from showing unreal fertility declines. Indeed, Kenya's crude birth rate declines only slightly from 50.2 to 48.8 (Anker and Knowles, 1983, 582) in the basic simulation run.

Bachue-Kenya, unlike Bachue-Philippines assumes that relative prices remain constant over the whole simulation period. The implicit justification of this assumption might be the open-economy character of the Kenyan economy. Indeed, this might be a better assumption than the "closed economy" one implicitly used in the Bachue-Philippines model in order to allow a variation of its internal terms of trade. [75] The flaw of fixed internal terms of trade, however, comes mostly from the role of non-tradables, in particular, services, whose relative price do vary in spite of the ""open"" character of an economy. This variation as shown by Kelley and Williamson (1984) might be a determinant for the volume of internal migration, and given the importance of services in total employment in developing countries, should constitute an important concern in a model emphasizing upon employment.

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[74] The parameters of fertility and mortality were obtained from macro and micro Kenyan information.

[75] It is actually difficult to see the Philippines as a "closed economy". It is possible, that the Bachue-Philippines model embodied a type of policy allowing the terms of trade variation in order to prevent explosive trade deficits.

In conclusion, it must be noticed that this model incorporates a "rural bias", in that population growth contributes to production in rural areas, but in urban areas it contributes mainly to consumption. Several doubts, can be raised about this model bias.

The fact that population contributes importantly to production in rural areas reflects the modelers exaggerated assumptions with respect to the rates of investment in agriculture, about 5 percent annually, even in the peasant sector. The above magnitude of investment, in view of an annual rate of growth of the agricultural labour force of 2-3 percent, ensures that the marginal product of labour does not decline.

In addition, there is an implicit assumption that the urban economy expansion does not relax the foreign constraint, on the contrary. Technological change in urban areas is zero while in rural areas is positive. Urban production is not affected by labour directly, it is determined independently of labour. Real wages in the cities are assumed to be higher than rural wages. Therefore internal migration, releases labour from a sector with a positive marginal contribution (agriculture), to be allocated in the urban economy with a lesser marginal productivity. Thus, the rate of growth of national production falls. Moreover, because real wages in the cities are higher, the consumption of imports and food increase. Thus, the exportable surplus of the economy diminishes and the requirement for imports increases with urbanization. The result is a declining rate of economic growth as urbanization proceeds.

Therefore, conclusions such as "reducing the rate of rural-urban migration stimulates economic growth since it results in greater economic production", (Anker and Knowles, 1983, 698) emerge in this model).

3.5.6 The Kelley Williamson and Cheethan 1972 Model

The Kelley Williamson and Cheethan (KWC) model is the first of the general-equilibrium models herein presented. This model constitutes a extremely simplified economic-demographic model. Indeed, its demographic side is totally under-developed. The KWC model, however, is included in practically all reviews of population modeling (Horlacher, 1981; Sanderson, 1978). The KWC was one of the first known models to use a general-equilibrium methodology to model population phenomena. It showed the potential of this methodology to integrate both the supply and demand sides of development.

The model attempts to depict Japan's development process from the mid 1880's to the First World War. In essence, the model portrays a closed economy composed by two sectors -manufactures and agriculture- located in the urban and the rural areas, respectively.

Production is modeled by the use of constants return to scale Ces production functions which combine labour and capital. Technological change is assumed to be higher in manufactures than in agriculture, and to be capital biased in manufactures and labour biased in agriculture. The elasticity of substitution of labour for capital is lower in manufactures than in agriculture.

All factors of production are rewarded according to the value of their marginal contribution to production, which also yields the functional distribution of income and also defines the savings process. Migration is a positive function of the urban-rural wage ratio and a negative function of transportation costs. Demand is modeled by using the Linear-Expenditure-System; it is assumed that food is a basic good and manufactures a luxury.

The KWC model has two versions, an equilibrium version and a disequilibrium version. The equilibrium version has no capability for analyzing population-development dynamics. Indeed, it assumes the periodical equalization of the rural wage with the urban one, with migration constituting the equilibrating mechanism. Obviously, an equilibrating behavior of migration provides an unrealistic portrait of migration and urbanization, and a distorted picture of the development process. The disequilibrium version, wherein neither wage equalization, nor rates of profit equalization are possible, depicts a realistic picture of the Japanese development process.

The conclusions of the KWC model were provocative since they challenged what were supposed to be established facts in the population-development literature. One of its most challenging conclusions was to suggest that a relatively rapid rate of population growth in a developing country could be beneficial to economic growth provided that it would increase the rental-wage ratio. In other words, this was equivalent to saying that a fast rate of population growth would affect positively savings, contrary to the common place in the early seventies that the dependency rate negatively affected savings.

3.5.7 The Mohan Model of India

Mohan's (1984) model is another example of a relatively simple application of the general equilibrium framework to the analysis of population phenomena.

Mohan attempts to explain the process of urbanization in India, and to ascertain the relative importance of population growth versus economic forces. Mohan challenges the conventional wisdom that explosive population growth is the driving force behind urbanization. Indeed, one of his most provocative conclusions is that a zero rate of population growth could generate a faster rate of urbanization than substantially higher rates of population growth. Therefore, Mohan concludes that a reduction in the rates of population growth in developing countries will not solve the problem of accelerated urbanization. Mohan's model is also interesting because it provides an important role to services generally neglected in development modeling. In general, Mohan's work draws heavily upon the work of Kelley, Williamson and Cheethan.

Mohan's model is a general equilibrium model of a closed economy, composed by three economic sectors, manufactures and services located in urban areas, and agriculture in rural areas. The model depicts a dualistic economy. It allows for technological change to be capital biased in manufactures and labour biased in agriculture. Total technological change, however, is assumed to be higher in agriculture than in manufactures. This assumption is debatable and certainly at odds with dualistic characteristics. Moreover, this assumption is crucial for Mohan's results.

Total technological change in services is assumed to be zero which is important for its labour absorption role. The modeling of production uses Ces production functions where elasticities of substitution between labour and capital are lower in manufactures, than in services and agriculture. Another crucial assumption on the production side is that manufacturing is more technically efficient than agriculture. That is, manufactures uses less units of inputs for a same unit of value added than agriculture. Demand is modeled by using the Linear Expenditure System (LEA), with the usual assumption of food having an income elasticity lower than one and all other goods an elasticity higher than one.

The migration side of Mohan's model is fairly under-developed assuming that a constant ratio differential k between the nominal urban and rural wage prevails during the whole simulation. Immigration behaves in an equilibrating manner for each period in order to equate the urban wage to the rural wage times this k ratio differential. Capital mobility is assumed to be lower than that of labour. The rest of the assumptions and description of the AGE model are typical of these models. The demographic side of this model is again under-developed, specifying that population growth is exogenous, its rate differs by rural-urban location, being higher in rural areas.

In Mohan's model a lower rate of population growth implies a higher rate of growth of per capita income.[74] This higher income per-capita, in turn, shifts consumption out of agricultural goods towards manufactures and services, and thus reorientates investment towards more technically efficient sectors. The result is an increase in the rate of GDP growth. Therefore, the demand induced higher production of urban goods induces an increase in urban employment, and thus promotes urbanization.

The assumption that the rate of technological change in agriculture is higher than in industry is crucial for Mohan's urbanization results. It implies that labour can be released from agriculture without affecting negatively agriculture production. If this were the case, the relative price of food in terms of urban goods would rise, reducing immigration, urbanization and economic growth.

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[74] This is definitionally implied by the use of constant returns to scale production functions

Mohan's conclusions are sensitive to the assumption that the rate of technological change is lower in agriculture than industry. In this case, a lower rate of population growth will produce basically a substantially lower pace of urbanization than the above case, and even urbanization might be reversed. The result is given because increased urbanization, by releasing labour from agriculture, reduces agricultural production and turns the term of trade in favor of agriculture.

3.5.8 The Adelman and Robinson model

The Adelman and Robinson (1978) model of the South-Korean economy is a general equilibrium model with emphasis on relations among demographic variables, income distribution and poverty. The model is large scale involving 29 productive sectors, 15 household categories, and six skill categories operating in each of the productive sectors. In sum, the model has about 3000 endogenous variables. Population is exogenous and its effect is represented by the labour force alone. The economy modeled is an open one which applies policies to insulate itself from the world-economy prices in some tradables. It is insulated from world prices in non-tradables. In short, the urban-rural terms of trade in this economy are allowed to vary.

The economy is again modeled under dualistic lines. In essence, capital has a very low degree of intersectoral mobility, the urban sector is more efficient than the agricultural sector, and the rate of total technological change and capital labour ratios are higher in the urban sector than in the rural sector. There are rigid wage structures. In demand, urban consumers display a relative preference for urban goods and vice versa.

The specification of migration assumes that spatial labour mobility is low. Adelman and Robinson define their migration specification in a non-equilibrating manner. Immigration will not be of sufficient magnitude as to equilibrate the urban wage to the rural wage times a constant, for each period as in Mohan above. Rural-urban migration is a positive function of the rural-urban income differential and a mobility parameter lower than one prevents the magnitude of the migration flow to increase by enough in order to achieve rural-urban wage equalization. It also specifies a minimum level of urban income, above the rural income, which induces rural-urban migration.

The Adelman and Robinson model has two basic conclusions. The first states that a higher rate of internal migration has a powerful and positive effect upon the equalization of the income distribution and contributes to increase economic growth. The second conclusion, which is fairly provocative, states that a high rate of population growth has more positive redistributive effects favoring the poor than a lower one.

The logic behind these conclusions, relating to the basic functioning of this model, is straightforward. Rural-urban migration transforms rural consumers into urban consumers, shifting demand away from food, this is the demand effect associated with internal migration. Rural-urban migration also has a production effect, which diminishes the relative growth of agricultural production with respect to urban production. The demand effect associated with rural-urban migration tends to reduce the agricultural terms of trade. The production effect tends to improve the agricultural terms of trade. The Adelman and Robinson model indicates that empirically the production effect dominates. That is, rural-urban migration turns the terms of trade in favor of agriculture.

Therefore, internal migration has obvious positive income distribution effects since it improves the wage for the rural-urban inmigrants and it improves the agricultural wage of the remaining rural workers. At the same time internal migration reduces the rural-urban wage differential. [77] The point that economic growth is enhanced by labour-migration, follows from the fact that either capital per capita is higher in urban areas or that technological change is higher, probably both being true.

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[77] It must be noted that this conclusion, in its policy guidelines, is particularly oriented to analyze the situation of those staying in the countryside whose lot is improved by rural-urban migration. It is interesting, as well, to compare this conclusion with Mohan's model above, stating a greater or equal misery for those who stay in the country side.

The assertion that a higher rate of population growth is more beneficial for the poor than a lower rate of population growth derives from a similar logic. It assumes that aggregate food consumption increases at the same rate as population, while food production increases at a lower rate. Specifically, it assumes that the rate of increase of food production declines as the rate of population increases. Therefore, the higher the rate of growth of population the greater will be the gap between demand and production of food, thus the greater will be the increase in the relative price of food in terms of urban goods. Therefore, the income of peasants will rise in relation with the income of urban workers and capitalists. The assertion assumes that the majority of the population and the poor are peasants.

This result emerges from an oversimplified model specification, which would be too long to criticize here. For instance, dynamic considerations are ignored. That is, in a longer period than the one covered by the model, ten years, declining returns to labour in agriculture will reduce the economy capacity to grow, producing a deterioration in the living conditions of peasants as well. In addition, it reveals other demographic-economic deficiencies in the model design. Specifically, the income-distribution effect of an increase in the rate of population growth should depend on the demographic behavior of different income groups, which the model does not distinguish. In addition, it should depend also on the distribution of land. For instance, if the acceleration in the rate of population growth comes mostly from poor peasants whose marginal product of labour is already low, the effect of an increase in the relative price of food on their welfare might be negative. That is, their own demand for food will increase more than their production of food. Finally, the result is also sensitive to assume that the poor are farmers and not a landless rural proletariat. In the latter case, by the model's logic, the poor will be better off with lower rather than higher rates of population growth.

3.5.9 The Kelley and Williamson Model

The Kelley and Williamson (1984) model was also oriented to analyze urbanization and internal migration in the Third World. This model attempted to analyze in a comprehensive manner the urbanization process, in order to ascertain the relative importance of economic and demographic forces. Indeed, the model achieves an impressive explanation of the whole population and development dynamics in the Third World in the last twenty years, and projects it until the end of the century.

The salient feature of this model is constituted by its treatment of services. This permits a better analysis of internal migration than most models do. The reason is that the relative price of services becomes positively dependent on rural-urban migration. Thus, high waves of internal migration increase the relative price of services raising the urban cost of living and ultimately reduce rural-urban migration.

This rural-urban migration link with services leads to one of the strongest conclusions of the model. This states that urban explosion in the Third World cannot occur, because internal migration is a process which regulates itself by the above endogenous mechanism.

The model depicts an "open-economy", and it is composed by seven sectors: manufactures, modern and informal services, and housing-services in the urban sector, and agriculture, informal rural services and housing rural services in the rural sector. The government sector, is also modeled; though, the sector only demands services while not directly producing them.

The general-equilibrium assumptions of this model are the typical ones. The model again portrays a dualistic economy in a similar way to Adelman and Robinson. In sum, total factor productivity growth is higher in the urban than in the rural sector. Technological change is capital biased in manufactures and neutral in agriculture. Total technological change in construction, housing and services is equal to zero. Modern services and manufactures production are represented by CES production functions, housing services and agriculture production by Cobb-Douglas, informal services by double log production functions in labour only. Capital mobility is low and only a fraction of investment moves across sectors. Spatial labour mobility between rural and urban areas is also low as it is explained in more detail below. Demand is modeled as in Adelman and Robinson, revealing a dualistic structure of preferences. The demographic side is under-developed, specifying population growth as a negative function of urbanization.

The migration specification postulates migration as a positive function of the real expected urban-rural wage differential and as a negative function of migration costs. That is, the expected nominal urban wage divided by the urban cost of living must be compared with the agricultural nominal wage divided by the rural cost of living. If a positive difference is obtained, and this difference is higher than the cost of migration then rural-urban migration proceeds. Wage expectations are obtained with past information which permits a low rural-urban migration rate. As said before, this migration specification depends importantly on the relative evolution of the cost of living differential. The feature of this evolution is a systematic rise in urban housing rents.

An additional finding, similar to Mohan's finding, is that while rapid population growth is behind rapid rural-urban migration and urbanization in the Third World, it does not totally explain these phenomena. On the contrary, rapid population growth reduces the rate at which a country urbanizes. The reason is that the increase in the supply of labour relative to the supply of capital, reduces the relative price of labour and increases its use in agriculture more than in other sectors. This is so, because agriculture is the more labour-intensive sector of the economy (Kelley and Williamson, 1984: 169). Thus, a higher rate of population growth tends to increase rather than decrease peasants retention in the country side.

4. THE MODEL

Introduction

The main elements in the modeling of population and development interaction in an African country, have been examined in the previous chapters.

In sum, what emerged from the above examination is that economic-demographic models of development adapted to an African reality, could be enriched by the following improvements.

In the first place, models should use multi-causal rather than partial approaches to examine economic-demographic phenomena. This is so because all economic-demographic phenomena are interrelated, and a model should capture the total set of interrelations. The analytical cost of not doing this, is seriously biased conclusions.

The most suitable economic framework to do this is that of general equilibrium models, provided they can be modified to reflect developing countries' structural economic features.

The demographic specifications of existent models are extremely under-developed. Poor specification arises mostly from a narrow application of modernization theory, and the mechanical application of cross-sectional estimates which attempt to fit this theory. Demographic reality is lost in this application. For instance, fertility and mortality variations are nonexistent because there are not economic cycles; fertility cannot but decline because it is specified as a negative function of urbanization; the represented relations between fertility and development do not capture their nonlinear essence.

To put it in another way, demographic specifications are poor because they have scarcely incorporated new theoretical approaches suitable to low level of development societies. These approaches situate fertility into its anthropological and political economy context, e.g. stating the rationality of high fertility for the poor and for peasants. Thus, they highlight the role of income distribution and emphasize the role of bio-social determinants of fertility, e.g. duration of breast-feeding period, which still are not incorporated into modeling.

Finally, the presence of sociopolitical elements important in explaining economic-demographic outcomes should be incorporated into models. For instance, the more equal land distribution in Kenya relative to the region, a political outcome, might be an important element explaining its high level of fertility. Nonetheless, models have difficulties in incorporating these crucial sociopolitical factors. Modelers have spanned the extremes of disregarding them totally to an absolutely ad-hoc consideration. The former approach produces absolute hybrid models with little resemblance to the reality analyzed. The latter falls in the opposite case, absolute theoretical irrelevance.

4.1 The Model Structure: Overview

4.1.1 Dualist Structure: The Modern and the Traditional Sector

The model consists at the most basic level of two macro-sectors representing the modern-traditional duality of our hypothetical African country. These sectors are denoted as the modern and or formal sector, and the traditional or informal sector, respectively. These sectors span urban-rural location.

The dualistic character of the economy is embedded in the following features of the model. First, the technologies of production used by each macro-sector differ. The modern sector uses capital-intensive techniques while the informal sector uses labour intensive techniques. The different nature of these techniques reflects partly a more structurally complex nature of a modern in comparison to a traditional industry. In addition each sector faces different relative factor prices.

Second, the labour market behavior is also differentiated along dualistic lines. In the modern sector, wages enjoy a certain degree of protection, though, they are not totally immune to market forces. In the informal sector, wages are determined solely by market forces.

Third, the process of savings-investment also displays a dualistic behavior. Specifically, the modern sector has greater access to capital than the informal sector. That is, investment funds generated within the modern sector have a degree of mobility within the different activities of the sector. The degree of mobility, however, is low. In the informal sector, each sub-sector must rely upon its own savings for investment purposes neither generating nor receiving investment funds from other sub-sectors. The model does not have a formal capital market.

Finally, dualism is also manifested in a differential rural-urban behavior with respect to consumption and fertility decisions. With regards to consumption, urban consumers display a greater preference for urban goods than for rural goods and vice versa. This preference, though, represents partly the greater need for using certain services in urban areas e.g. transportation, in comparison to rural areas.

With regards to fertility, urban residence is assumed to change the values determining the parental preference for large family size, towards a preference for small family size. Instead, residence in rural areas is assumed to prevent and/or to slow down a change in these values.

4.1.2 Production Structure

The formal and the informal sector, are divided into several sub-sectors of production. The formal macro-sector consists of manufacturing, modern services, housing services and construction sectors within the urban area, and by a big-farms sector in the rural area. There is not an explicit housing services sector in rural areas. [78]

The informal, or traditional macro-sector, consists of informal services in the urban area and a peasant or small farms sector in the rural area. In the model, all economic activities besides agriculture have an urban location. [79]

The manufacturing sector, produces manufactures for final consumption, intermediate use and machinery or capital. Modern services produce all the services associated generally with governmental activity e.g., health, education, administration (except defense which is excluded from the model). It produces services associated with private activities, e.g. trade, recreation, transportation, repairs and cleaning. Informal services produce services other than those produced by the modern sector. Services also satisfy intermediate demand. Construction builds housing-structures which are used by the housing sector to provide housing services, and by the government to build infrastructure. Finally, both the big-farm and the peasant small-farm sector produce a homogeneous agricultural good. This good is consumed as food, used as intermediate product by the other sectors, and exported.

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[78] It is assumed that housing land rents in rural areas are negligible.

[79] This in practical terms, means an upper bias in the percent urban (urbanization) of the population modeled.

4.1.3 The Government

The government role is to ensure the provision of health and education to the population, the building of necessary infrastructure and to administrate the functioning of the economy.

The government contracts the production and provision of services to the population from the services sector. In addition, it also contracts the production of infrastructure building from the construction sector. The population does not pay for the services, its full cost is assumed by the government.

Therefore, employment generation by the government is captured indirectly in the model. Specifically, it corresponds to the employment required by the construction and services sectors, in producing the contracted amount of services and infrastructure demanded by the government.[10]

The government revenues to finance the above expenditures come from indirect taxes, tariff revenues on imports, and rents on urban land. It is assumed that the government monopolizes the supply of the urban land.

The tax structure was designed to favour industry and discriminate against agriculture in order to represent a frequent industrial bias displayed by developing countries, clearly present in Africa (Ghai and Radwan, 1983; Todaro, 1985).

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[10] This form of modeling the government must be taken as a convenient abstract simplification of its actual behavior, and it follows approximately the government-modeling by Kelley and Williamsom (1984) economic-demographic model.

Finally, it was assumed that a government deficit is covered either by foreign savings or by an external-trade surplus.

4.1.4 The External Sector

The hypothetical African economy was modeled as a small-open economy.[81] Two of the goods produced in the model are tradables (manufactures and agricultural goods) and the prices of these goods are determined by world prices. It was assumed that the production of manufactures is protected through the application of a tariff on its world price. The producer prices of agricultural goods were assumed to be highly taxed hence creating a large gap between the world and the producer price. The exchange rate is assumed to be fixed and set equal to unity.

Non-competitive imports[82] are imported by the country to be used as inputs in the productive process. These might be thought of, as oil, and/or components in the productive process, which are not produced domestically.

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[81] Actually, all African economies do constitute small-open economies. See World Bank (1981).

[82] This category means necessary inputs in the production process which can not be produced domestically and have to be imported. Its relevance is crucial in the case of developing countries, given that it relates to to the fuel (oil) needs by the industry. Since the oil crisis affecting Third World industrialization, its treatment has become very topical within the development literature (Taylor, 1979). On the other hand, this category even if we do not understand it strictly as oil, is very telling in infant industrialization processes, where manufacture production may mean just the assembling of imported components.

Since the model assumes only one good for each productive sector, it can deal only with net-exports for each of the tradables. That is, if the consumption of the good in question is greater than its production, the good is imported, or its net-exports are negative, and vice versa.

Balance of payments equilibrium assumes the possibility of accommodating foreign savings. It was assumed, that a deficit in trade can be covered by foreign savings and/or government savings. Government deficits can be covered by trade surpluses and/or foreign savings. This closure rule has been used in models by Johansen (1960), Dervis (1975) and Lisy and Taylor (1980). With this closure rule, the external debt besides the rate of economic growth, becomes an indicator of population pressure.

In contrast, in models which use a closure rule constraining imports to equal exports, only the rate of economic growth reflects the full impact of population pressure. Our rule was based on the stylized fact of an important secular growth of the external debt in African countries.[13]

4.1.5 The Economic Actors in the Model: Workers and Capitalists

There are two kinds of workers for which the model provides a detailed treatment: skilled and unskilled. The former are defined as workers with more than completed primary schooling; the latter as workers whose schooling is lesser than completed primary schooling.

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[13] See chapter one.

Only the modern sector uses productive techniques which require skilled workers. Thus, skilled workers are only employed in manufactures, modern services and construction. Neither agriculture nor the informal services uses techniques which require skilled workers. All productive sectors require unskilled workers and both unskilled and skilled can be employed to do these jobs. Unskilled workers, however, cannot be used to do jobs which require of skills.

The number of capitalists is calculated as a fraction of sectoral employment. The fraction was based on data on self-employment by sector provided by Bachue-Kenya (Anker and Knowles, 1983).

4.2 The Non-Equilibrium Character of The Model

The model portrays economic development as a process of dynamic adjustment to long run constraints. Along the time-path there are counteracting endogenous economic-demographic forces which push the economy back and forward towards static economic equilibrium. These forces achieve a certain dynamic balance. Thus, the economy never really achieves equilibrium nor departs explosively from it.[44]

The model displays a disequilibrium character in the following aspects. First, the rates of return to capital among different economic sectors do not equalize for each period, and they may never equalize. This is due to the assumption of a low degree of capital mobility.

Second, there is a wage differential between unskilled workers of the formal sector and those of the informal sector, in urban areas. The wage differential reflects an institutional rule fixing a minimum wage in the formal sector, generally above the endogenous wage in the informal sector. The determination of the minimum wage takes into account market forces. Specifically, it determines the minimum wage in order to limit informal sector employment (underemployment). Thus, the wage differential will vary, e.g. being minimized in the upswing of the economic cycle, but in general will continue favoring the workers of the modern sector. The point will be discussed in detail later.

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[44] Actually, there is more to learn from the development process viewing this as a sequence of disequilibrium stages; rather than one of equilibrium (Kelley, 1981; Kelley and Williamson, 1984).

Third, rural-urban migration has a disequilibrium character which draws upon Todaro's (1969) modeling of rural urban migration. In Todaro's model, migration in every period proceeds until the urban expected wage[85] is equalized with the rural wage. This implies that rural-urban mobility is high, and/or that internal migration is rapidly responsive to current market conditions and assumes a high degree of market information. In our model, the urban supply of labour for the current period is affected only by internal-migration which took place at the end of the previous period. Thus, internal migration could be equilibrating in a Todaro manner only by chance.

What our specification emphasizes is that migration decisions tend to be less responsive to market opportunities than in Todaro's model (1969). There are three reasons for this specification. First, in a predominantly rural economy the attachment to land and farming as a way of life is strong, determining a low rate of rural-urban mobility (Livingston, 1986; Swan et al., 1987). Second, the speed of information spreading in a low developed economy tends to be slow (Kelley and Williamson, 1984). Third, modern-sector employment probabilities which assume a lottery mechanism as in Todaro's model, in which everybody has an equal opportunity of employment in the modern sector are unrealistic (Williamson, 1988). In general, realism suggests a more cautious formation of urban wage expectations. This can be represented as one in which the expected wage is based on past information. The result as said before, is one of disequilibrium in internal migration.[86]

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[85] This is defined as the probability of finding a job in the modern sector multiplied by the modern sector wage.

Institutional wage determination in the modern sector and internal migration which is not equilibrating, determines, in summary, the following disequilibrium character of the labour market. In urban areas, the modern-sector wage is above equilibrium while the informal-sector wage is in equilibrium. That is, there is basically lack of employment for workers in the modern sector who are willing to work at the institutional wage, while there is employment for whoever wants to work at the informal sector wage. The rural labour market is always in equilibrium and/or there is not unemployment in rural areas. Finally, the national labour market is in disequilibrium in the sense that the urban expected wage does not always equal the rural wage.

In the market for non-tradables goods, equilibrium is achieved every period. That is, prices equate demand to supply in each non-tradable goods-market: services, construction and housing.

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[86] Adelman and Robinson (1978) model of Korea has a similar specification to ours.

4.2.1 Low Motion of Under-developed Economies and Recursivity in The Model

General equilibrium models often assume the existence of a simultaneous process of adjustment among unrelated decisions of individual consumers and producers. This adjustment leads the economy fast and smoothly toward equilibrium each period in all markets of goods and productive factors.

This process so called "tatonnement", implies assumptions with respect to the functioning of the economy which might be unrealistic for the case of less developed countries. In particular, it assumes a high mobility of productive factors, e.g. capital and labour, in response to market opportunities, and a high speed and amount of market information.[87]

A fast and smooth adjustment implied by the tatonnement process depicts more accurately the functioning of a highly modernized economy rather than that of an African under-developed economy. Specifically, the adjustment towards equilibrium in a modern economy might be fast and smooth, precisely because minor departures from it generate enormous auto-corrective trends. On the contrary, in a low-level of development economy, the road toward equilibrium, which might be never achieved, must be characterized by a slow speed and sharp oscilations.

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[87] For instance, the tatonnement process would imply that an increase in the urban demand for labour in a period, is met immediately by greater rural-urban migration, which as suggested before is not true. The low mobility of capital in low level of development countries is due mostly to the absence of a capital market and/or imperfections in this. For instance, peasants and/or informal sector producers do not have access to capital loans. In addition, international capital tends to be allocated into specific modern sector activities rather than to move among internal domestic sectors. Certainly, it is often the case that these modern sector activities enjoy a high degree of protection (Todaro, 1985).

Thus, several other assumptions were undertaken in order to depict more realistically the functioning of a low level of development economy. First, it was assumed that urban modern-sector producers base their production decisions on expected prices. These expected prices are forecasted by these producers in view of past experience. ''

Second, because the informal sector is competitive, producers do not expect their actions to affect prices. It is assumed that these producers base their production decisions upon observed current prices. That is, they do not use price expectations.

Third, it is assumed that investment decisions are also based on past information about relative sectoral profits.''

''This assumption can be justified precisely by the low motion of this economy. That is, in an economy with little factor mobility, little information and slow entry of new producers, e.g. arising supply shortages are not rapidly corrected as in a high motion economy. Thus, shortages are met by price increases rather than quantity increases generating "abnormal" profits. By the same token, excess supply situations might produce sharper price declines and greater losses than in a more flexible economy. In sum, great variations in price might be expected in this type of economy. Therefore, it might be realistic to state, that the behavior of "informed" producers is based on expected prices rather than on current prices.

''This assumption becomes important, when the degree of capital mobility in the model is increased. With low capital mobility the bulk of sectoral profits is reinvested in the

Finally, it was assumed that the essence of this economy functioning, could be better specified recursively rather than simultaneously.

4.2.1.1 Recursive Specification of the Economy Functioning and The Model Solution in Three Stages

In short, the recursive specification of the model implies that this is solved in three stages.

In the first stage, the model solves for production, intermediate inputs allocation, labour allocation and modern sector wages. It also solves for the price of construction goods. The detail of this solution will be discussed in detail later.

In this stage, the capital stocks have been updated by subtracting depreciation from last period stocks, and by adding real investment. The urban stock of skilled and unskilled labour, and the stock of rural labour have been updated by internal migration, natural increase, and the policy-education related rate of increase for skill categories.[20] These stocks are thus fixed for the current period.

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[19] (cont'd) own sector.

[20] The urban aggregate supply of workers increases by internal migration and the natural increase of the urban population of workers. The primary school incremental rate decided by the government defines the rate of increase for occupational category. This policy, however, affects only the new urban cohort of workers. The number of urban skilled and unskilled workers, thus, is mostly affected by the amount of skilled and unskilled inmigrants. A symmetric argument explains the evolution of the skill composition of the rural labour force.

The government at this stage expands education and health according to the long run targets with respect to these social variables. In addition, it expands infrastructure according to the previous period expansion in agricultural and urban land. As well, it expands (reduces) administrative expenditure according to last period registered expansion (reduction) in GDP, basically. The government does not know what its current revenues will be.

In the second stage, the model solves simultaneously for the urban informal wage, the agricultural wage, prices of non-tradables, consumption and profits. For the solution, the model uses as exogenous variables all those solved in the first stage. It is worth noting that the amount of imports has not been constrained either in the first or in the second stage.

Finally, in the third stage, the model solves for migration, fertility, mortality investment funds, government deficit or surplus, and foreign trade or surplus. The solution of these variables uses the variables solved in the previous stages as exogenous variables. For instance, the determinants of mortality: real wage, food consumption and the real educational expansion, were solved in the first two stages.

In sum, the third stage feeds the exogenous conditions for the solution of the first stage of the next period. For instance, fertility and mortality determine the rate of growth of population, and thus permits its updating for the next period. The recursive specification implies the possibility for modeling adaptative reactions e.g. the government with full knowledge of the fiscal and external trade situation: e.g. deficit, could react by devaluating and/or reducing the expansion of real government expansion.

The above recursive specification is justified on grounds of the assumptions of a slow adjustment of the economy to economic shocks. ''

While the recursive specification might be a realistic one, it entails disadvantages. Specifically, it might exaggerate the fluctuations in prices, employment and national income, because of the assumptions determining adjustments to economic shocks.

''The specification also relied on a compromise between feasibility and theory. It is extremely difficult for an algorithm to find simultaneous solutions when many disequilibrium conditions are stated. These conditions, nonetheless, were a substantive component of our view of the economic development process. See Dervis et al. (1982) explanation of the difficulties in solving non-pedestrian simultaneous systems, and how algorithms which reduce simultaneity in the system might represent the behavior of an economy.

4.3 Key Model Blocks or Components

4.3.1 Capital Formation Block

The basic assumptions with respect to capital formation are the following. Capital mobility is low. Specifically, capital becomes fixed once installed and/or only new investment is mobile across sectors. This mobility, in turn, is constrained solely to the modern sector (Kouwenaar, 1988; Kelley and Williamson, 1984; Dervis et al., 1982). That is, investment funds generated in any of the different activities of the modern sector can flow from one activity to another, while the traditional (informal) sectors do not generate nor receive intra-sectoral investment flows.

Investment for the current period is decided on the basis of information of the two past periods with respect to observed profit rate differentials (Dervis et al., 1982). This is an expectation formation mechanism, albeit a very simple one. The average sectoral rate of profits of the two past periods is compared with the average rate of profits for the whole modern sector.[2] Part of the investment funds generated in a sector will be retained within the sector. The other part will go where the rate of profit was highest. The magnitude of these fractions, staying and going, is regulated by a parameter of capital mobility (KMOV), which may range from 0 to 1.[13]

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[2] There are two versions of this procedure. In the first, the average rate for the modern sector profits is calculated each time by the computer program. In the second, a fixed average rate for the whole simulation, calculated among several runs was used. The difference between both simulations was negligible. Therefore, the second procedure was commonly used due to its greater computational stability.

The investment for the current period is undertaken with savings generated in the previous period. These savings, for the modern sector, are the residual of profits minus capitalists consumption.[14] Capital accumulation in the period is obtained from adjusting the stock of capital by depreciation, assumed common to all sectors at 6 percent, and adding real sectoral investment (nominal sectoral investment divided by the exogenous price of capital).

Investment in the traditional sector, corresponds to a fixed rate of savings by peasants and informal sector entrepreneurs. These rates are simply the share of capital in the production function for informal services, 30 percent, and 20 percent of total value added in the case of peasants. These rates may sound high. They may be justified, however, by the requirement of individual sectors close to and at poverty lines to maintain subsistence production. This might be the case in particular for peasants. In any event, these are not sacred parametric values.

There is not an explicit modeling of foreign-investment by specific sectors. However, the assumption that foreign savings must be equal to the total deficit in the balance of payments plus the government deficit ensures that an accommodating flow of foreign savings exists.

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[13] For most runs, the parameter was fixed in 0.3.

[14] Capitalist consumption, defined later, is basically a linear function of capitalist income. This latter is defined as total profits minus retained profits. Retained profits were assumed to be twenty percent of total profits. The marginal propensity to consume of capitalists was assumed equal to 0.6.

4.3.1.1 Capital Accumulation Equations

The equational treatment of the capital accumulation process in the modern sector follows:

Profits for manufactures, modern services and construction are defined as follows:

$$PFi=PVi*VAi-Li*WUU-LSi*WUS \quad [4.1]$$

where,

PFi=Profits sector i

VAi=Value added sector i

PVi=Value added price, sector i

Li=Unskilled labour employed in i

Lsi=Skilled labour employed in i

WUU=Unskilled wage

WUS=Skilled wage

where i= 1, MF1 (manufactures)
2, MS2 (modern services)
4, MC4 (construction)

Profits for housing-services equal;

$$PF3=PV3*VAHS3-RTUL*TUL \quad [4.2]$$

where,

PF3=Sectoral profits

VAHS3=Value added housing-services

PV3=Value added price housing-services

RTUL=Urban land rent

TUL=Urban land

Profits for the Big Farms are equal to;

$$PF6=PV6*VA6-L6*Conspe \qquad [4.3]$$

where,

PF6=Big-farms profits

PV6=Value added price big farms

VA6=Value added Big Farms

L6=Labour employed by big farms

Conspe=wage paid by big-farms

Once profits have been obtained, the number of capitalists and capitalists disposable income is obtained as follows:

$$NK=\frac{L1+L2+L4+L6+LS1+LS2+LS4}{50} \qquad [4.4]$$

NK=Number of capitalists;

$$YK=\frac{0.8*APFMS}{NK} \qquad [4.5]$$

$$APFMS=PF1+PF2+PF3+PF4+PF6 \qquad [4.6]$$

where,

YK=Per-capitalist disposable income

APFMS=Aggregated profits modern sector

Capitalists nominal consumption and capitalists-savings follow;

$$CK=BKC*PINDEX+MPCK*YK \qquad [4.7]$$

where,

CK=Per-capitalist nominal consumption

BKC=Basic nominal consumption

PINDEX=Price index

MPCK=Marginal propensity to consume

$$INVCOF=\frac{CK*NK}{APFMS} \qquad [4.8]$$

INVCOF=Fraction of total profits consumed

and sectoral savings or investable sectoral funds are

$$SHSi=PFi*(1-INVCOF) \qquad [4.9]$$

The allocation of the sectoral savings SHSi, to the origin sector i, or to another sector j, obeys the following process. First, the sectoral rates of profits for each sector are calculated. Second, they are compared with the average rate of profits for the modern sector, giving a new variable (AUXi), which plays the crucial role of inter-sectoral investment allocation. It is convenient to note that the process is a lagged one. That is, the savings generated above, will be invested in the next period and/or current period investment corresponds to past periods savings.

Specifically, entrepreneurs will actually compare their average rate of profits between the current and the last period with the mean rate of profits for the modern sector in the same two periods, when deciding investment allocation for the next period. The equations below represent just one period to keep the presentation simple. [45]

$$RRKi=\frac{PFi}{PC1*Ki} \qquad [4.10]$$

where,

RRKi=Sectoral rate of profits

PFi=Sectoral total profits

PC1=Price of manufactures

Ki=Sectoral stock of capital

$$ARRK=\frac{RRK1+RRK2+RRK3+RRK4+RRK6}{5} \qquad [4.11]$$

ARRK=Average rate of profits modern sector

$$AUXi=\frac{RRKi}{ARRK}-1 \qquad [4.12]$$

Then, the intersectoral investment decision depends basically on whether AUXi is positive or negative. If AUXi is positive, the sector will receive funds. If AUXi is negative, part of the sector savings will go to other sector.

Let us illustrate the procedure for a negative value of AUXI. The investment funds generated by the sector can be divided in:

$$Iii=LAG(SHSi)+AUXi*KMOV*LAG(SHS1) \qquad [4.13]$$

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[45] To see the detailed generation of investment it is convenient to examine the computer-program appendix, which for its extension is not reproduced here.

$$Iij=AUXi*KMOV*LAG(SHSi) \qquad [4.14]$$

Iii=investment funds from i, remaining in i

Iij=investment funds from i, going to j

KMOV=capital mobility parameter

A negative AUXi, in this case, subtracts a fraction AUXi*KMOV from the total available sectoral investment funds LAG(SHSi) generated in the last period. This fraction will go to the most profitable sector.

The importance of the parameter of capital mobility KMOV is worth stressing. If this equals zero, all savings funds generated in a sector remain in the sector, no matter what the profitability of the sector. It is also worth noting that a negative AUX1 will range between -1 to 0. Profits rates and investment funds (originated in the sector) were assumed to be zero in the case of loses.

After the intersectoral investment allocation has been decided, capital accumulation in the modern sector is determined.

$$Ki=LAG(Ki)*(1-DEP)+\frac{Ii}{PC1} \qquad [4.15]$$

Lag=lag or value in the last period

Ki=Sectoral capital

DEP=depreciation rate

Ii=sectoral nominal investment

PC1=Final price of Manufactures

Note: For the case of housing services, Ki, represents capital structures, and PCi becomes PC4.

In the case of the traditional sector, the accumulation of capital proceeds in a simple manner, given the absence of capital mobility.

For the urban informal sector,

$$I5=LAG(PV5)*SK5*LAG(VAIS5) \qquad [4.16]$$

$$K5=LAG(K5)*(1-DEP)+\frac{I5}{PC1} \qquad [4.17]$$

where

I5=Sectoral nominal investment

PV5=Sectoral value added price

SK5=Cobb-Douglas coefficient of capital in production

For the small farms sector;

$$Ii=LAG(WA-CONSPE)*Li \qquad [4.18]$$

where

WA=Value of the average product, or institutional agricultural wage

i=70 (small-small farms), i=71 (small-medium farms)

Conspe=Per-peasant nominal consumption

4.3.2 The Labour Market Block

Labour mobility exists among all sectors. The degree of rural-urban mobility is assumed to be lower than that required to erase the urban-rural expected real wage differential. This point will be addressed later. The urban and rural supply of workers is updated from period to period by natural increase and migration. The participation rate in the labour force is assumed to remain constant. Thus, the rural and the urban supply of the labour force are fixed for the current period. (Dervis et al., 1982; Kelley and Williamson, 1984; Adelman and Robinson, 1978).[16]

Each productive sector, in the urban modern sector, hires labour until the point where the expected value of the marginal product of labour becomes equal to the initial institutional modern sector wage.[17] This is determined by the government in negotiation with the unions according to a rule explained later.

Residual labour of the current stock of urban workers, not hired in the formal sector, is hired in the informal sector, except for a percentage of skilled workers. They prefer to remain unemployed if there is not available modern sector skilled employment. The urban informal sector wage is not regulated and equals the resultant value added price times the marginal product of labour.

In the rural areas, labour is hired first by big farms in a fixed proportion with land. The residual rural labour finds employment in the small farms sector. The relevant wage in the small farms sector is the value of the average product of value added which is shared by peasants. The big farms are forced to pay a wage equal to the individual nominal consumption of peasants, otherwise, they would not obtain labour.

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[16] The model has no explicit population besides workers. That is, the behavior of the population is assumed to be similar to that of the labour force. And the rate of population growth is assumed to be equal to the rate of growth of the labour force.

[17] The production functions, necessary to the calculation of the marginal product, are Cobb-Douglas.

4.3.2.1 Institutional Rule for Modern Sector Wage Determination

The government determines the modern sector wage seeking to minimize employment in the urban informal sector (underemployment). This rule embodies the conception that the relevant urban-employment issue in the Third world is underemployment, or employment in the informal sector rather than overt unemployment in the modern sector. '•

Specifically, the government at the end of each period, assesses the size of informal services employment relative to the size of the urban labour force. If the informal sector occupies more than thirty percent of the urban labour force, the modern sector wage will be reduced by the amount necessary to restore the size of the informal sector to twenty percent of the urban labour force. '' The latter

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'•Specifically, unemployed people generally correspond to workers whose relatively better off social and economic position, allows them to be unemployed. The majority of workers, however, have no choice but to work or risk starvation (Edwards, 1974; Squire, 1981). Indeed, in developing countries for "each unemployed there were three to four underemployed" (Kannappan 1985). Underemployment, means work at a very low level of productivity, thus generating, sometimes, a too low income.

''These limits are to some extent arbitrary, however, they were chosen to replicate the stylized facts of development of the region. In fact, different limits were tried in preliminar experimental simulations and later in the policy analysis. In sum, dramatic changes in them produce dramatic changes in the replication of the pattern of development of limit of twenty percent, and no less, might be considered as a result of the union bargaining power, since a lower percentage would entail in general a lower modern sector wage.

The urban unions of the modern sector, have also the right to a periodic wage increase corresponding to a share of productivity growth and the cost of living increase. Specifically, the wage is adjusted by a weighed sum of the two past periods rise in the cost of living.[100] The resultant wage is the floor-wage upon which the 'government rule' operates. That is, a greater underemployment than the one tolerated in the previous periods erases, of course, all of this gain.

Nevertheless, within the current period, the modern sector demand for urban labour might exceed in certain cases, the fixed supply of urban labour. In this case, the institutional wage is too low. In this situation, the modern sector wage will rise endogenously until the point that the modern sector absorbs 85 percent of the available urban labour supply, while the informal sector absorbs 15 percent of it. The available labour supply is defined as 92 percent[101] of the skilled workers plus the total of the

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[99] (cont'd) the region. Specifically, experiments in which the degree of protection of modern sector wages is increased by raising the limit of maximum informal sector employment, bring a sharp reduction in economic growth and internal migration.

[100] The weights are eighty percent for the last period cost of living and twenty percent for the cost of living of two periods ago.

[101] The choice of 92 instead of e.g. 95 or 90 is indeed arbitrary. In doing these type of assumptions, we are forced

unskilled workers.

Skilled unemployment is assumed equal to 8 percent. These are skilled workers who refuse to work as unskilled. This unemployment is partly the result of the assumption that skilled wage always equal 3 times the unskilled wage, which produces an over-supply of skilled workers.[102]

The rule for modern-sector wage determination, captures the situation of Africa's labour market. On the one hand, it reflects the actual existence of institutional forces protecting the modern sector wage, documented elsewhere. But also, it permits the role of market forces, capturing the important role of the informal sector in these economies, and reflecting the influence of rapid internal migration in pressing down urban sector wages. In other words, the rule accepts the existence of modern sector wage protection, but emphasizes that this must be weak in case of relative labour surplus economies. Further, the rule approaches Kenyan reality of modern sector real wage reduction in the last twenty years (Gugler, 1987; Todaro, 1985; Bloom and Freeman, 1987).[103]

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[101] (cont'd) to follow general stylized facts of development because of the absence of adequate data.

[102] See Blaug (1987) and Yap (1976) for the profile of unemployed workers in developing countries. See Mohan (1984) for constant differentials among skills.

[103] For other rules see Calvo (1978) and Gregory (1975, 1980).

4.3.2.2 Labour Equations

Urban Labour Stock Updating

$$SUS=LAG(SUS)+Vero\ast LAG(SUS+SUU)\ast NIUU+LAG(MIGS) \qquad [4.19]$$

$$SUU=LAG(SUU)+(1-Vero)\ast LAG(SUS+SUU)\ast NIUU+LAG(MIGU) \qquad [4.20]$$

$$VERO=0.5\ast e^{REDU\ast T} \qquad [4.21]$$

SUS=Supply of skilled labour in t

SUU=Supply of unskilled labour in t

NIUU=Urban natural rate of increase

MIGS=Net migration of skilled

MIGU=Net migration of unskilled

LAG=Lag or last period

e=number e

REDU=Urban primary education incremental rate

T=time

Labour Hiring in the modern sector

$$L_i=\left(\frac{EPV_i\ast SL_i\ast C_i\ast e^{TN_i\ast T}\ast K_i^{Sk_i}\ast (WUU\ast SLS_1)^{SLS_1}}{WUU(WUS\ast SL_1)^{SLS_1}}\right)^{\frac{-1}{SL_i+SLS_i-1}} \qquad [4.22]$$

and skilled labour,

$$LSi=\frac{WUU}{WUS}*\frac{SLSi}{SLi}*Li \qquad [4.23]$$

where

Ci=Constant of the Cobb-Douglas

EPVi=Expected value added price sector i

Li=Unskilled labour sector i

Lsi=Skilled labour sector i

SLi=Unskilled labour coefficient in the Cobb-Douglas

SLSi=Skilled labour coefficient in the Cobb-Douglas

Ki=Capital stock in the sector

SKSi=capital coefficient in the Cobb-Douglas

i=1, 2, 4= manufactures, modern services, construction

Wuu, Wus, unskilled and skilled wage in the modern sector

Labour hiring in the Informal Sector

$$L5=(0.92*SUS)+SUU-TSSJ-TSUJ \qquad [4.24]$$

$$TSSJ=LS1+LS2+LS4 \qquad [4.25]$$

$$TSUJ=L1+L2+L4 \qquad [4.26]$$

TSSJ=Total skilled employment in the modern sector

TSUJ=Total unskilled employment in the modern sector

Labour in the Rural Sector

Rural Labour Stock Updating

$$TRL = LAG(TRL)*(1+NIRR)-LAG(MIGT) \tag{4.27}$$

TRL=Total rural labour force in period t

NIRR=Rural natural rate of increase

MIGT=Net total rural-urban migration (workers)

Labour demand big farms

$$L6=HRL*TR6 \tag{4.28}$$

L6=Labour in big-farms

HRL=Fixed ratio labour/land

TR6=Big-farms land

Labour demand small farms

$$STA=TRL-L6 \tag{4.29}$$

$$AUXIL1=\frac{L70}{L71}$$

$$AUXIL1=\left(\frac{C70*e^{TN70*T}*K70^{SK70}*TR70^{STR70}}{C71*e^{TN71*T}*K71^{SK71}*TR71^{STR71}}\right)^{\frac{-1}{1-SL70}} \tag{4.30}$$

$$STA=AUXIL1*L71+L71=STA \tag{4.31}$$

$$L71=\frac{STA}{(AUXIL1+1)} \tag{4.32}$$

L70=AUXIL1*L71 [4.33]

L70=Labour in small-small farms

L71=Labour in small-medium farms

C70, C71, constants of sectoral (70, 71)Cobb-Douglas

TR70, TR71, land small-small and small-medium, respectively.

K70, K71 capital stocks, small-small and small-medium farms.

TN70, TN71 rates of technological change for 70, 71

SK70, SK71, capital-coefficients in Cobb-Douglas for 70, 71

SL70, SL71, labour coefficients in Cobb-Douglas for 70, 71

70, 71 denote small-small and small-medium farms

The above equations, are derived from the condition that the value of the marginal product of labour is equated between the two small-farms sub-sectors.

4.3.3 Migration Block

4.3.3.1 The Migration Decision

The migration decision is taken at the end of each period, or in the third stage of the model solution. The decision is based on the expected rural-urban real wage differential. This expectation, in turn, is based on the conditions of wages, employment and cost of living obtained in the period, which potential migrants expect to prevail in the next period.

The expected rural-urban real wage differential is defined as the ratio of the expected urban wage divided by the urban cost of living and the rural wage divided by the rural cost of living. In turn, the expected urban wage is defined as the probability of finding an urban job times its respective wage. This probability is defined as total jobs available divided by the supply of workers. There are three types of urban jobs, skilled and unskilled jobs in the modern or formal sector, and informal sector jobs. Hence, there are three different wages.

The modern sector labour market is assumed to display 'bumping' characteristics. That is, more educated workers (skilled) are preferred over less educated ones (unskilled), regardless the skill-requirements for the job in question (Sabot, 1979). Since, skilled workers can work either in skilled or in unskilled modern sector jobs, they will displace unskilled potential workers if there is not enough availability of skilled jobs. In the informal sector, every worker can find a job, thus, displacement does not take place.

Hence, expected urban wages differ by skill category. Specifically, a skilled worker has two probabilities of modern sector-job, one as skilled worker (PBSS), and another as unskilled worker (PBSU). It also has a probability equal to one of finding a job in the informal sector. Thus, the skilled worker faces three expected wages. The relevant one for the decision migration is the greater of the three (Sabot, 1979).

The unskilled worker can find only unskilled jobs in the modern sector. Since he is displaced from these jobs by skilled workers, his probability of finding a modern sector unskilled job (PBUU) is generally lesser than the one of a skilled worker. Hence, his expected urban wage is lesser than the one of a skilled worker. He also has a probability equal to one of finding an informal sector work.[104]

As said before, the probability of finding employment in the informal sector is one for both skilled and unskilled. There is an exception, however, in the case when the informal sector wage surpasses the modern sector unskilled wage. In this case, it was assumed that the potential inmigrant judges the probability of a repetition of this event as nil, and considers in his expected wage calculation the informal wage of two periods ago.

The expected urban-rural real wage differential takes into account the cost of living differential. Specifically, the expected urban wage is divided by the cost of a minimum basket of goods and services required to live in the cities, in order to obtain a sort of basic expected urban real wage relevant to the migration decision. This is compared to the actual basic real wage in agriculture, which is the average agricultural wage divided by the cost of the minimum basket of goods and services required to live in rural areas. The urban basket is quantitatively larger than the corresponding rural basket, reflecting the greater requirement for housing and services in cities.

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[104] These probabilities vary with several endogenous factors e.g. employment generation by skill and internal-migration by skill. Thus, their evolution through time is not that clear-cut. In general, though, it can be said roughly that the probability of skilled employment in the modern sector for skilled workers (PBSS) will always be well below one. The probability of unskilled employment in the modern sector for skilled workers (PBSU), will be exceptionally lower than one. And finally that the probability of unskilled employment in the modern sector for unskilled workers (PBUU) may become zero.

The model calculates net migration as follows. If the differential is greater than one, that is, if the basic expected real urban wage is greater than the actual basic real rural wage, net rural-urban migration is obtained. Conversely, if the differential is lesser than one, urban-rural migration is obtained.

Net rural-urban migration by category is equal to the differential minus one, multiplied by the specific skill rural-urban mobility parameter. When the differential is lower than one and urban-rural migration obtains, the calculation is slightly modified. In this case, the mobility parameter becomes a variable negatively related to the distance beyond the urban informal wage and a "critical" survival wage.

4.3.3.2 Migration and The Relation between Formal and Informal Services

The manner in which the urban informal sector is integrated with the rest of the economy is crucial in determining the extent and pace of migration (Mazumdar, 1977; Williamson, 1988). The demand for services was modeled using an Armington specification which treats formal and informal services as substitutes (Dervis et al., 1982).

In particular, it was assumed that informal services were a reasonable substitute for formal services. Thus, a high elasticity of substitution among them was assumed. It was also assumed that informal services were less appealable than formal ones. Thus, a relative small distribution parameter was assumed. The specific choice of a value of (2) for the elasticity and of a value of (0.26) for the distribution parameter, came after experimental simulation with other values e.g. 5 and 1.5 (elasticity).[105]

There is room for discussion, whether these parameters are or not adequate. We think that our specification is more realistic than one which assumes that informal services constitute a totally different market from the formal services market. In this case, the elasticity of substitution would be zero. In fact, the high elasticity chosen points at a less stereotyped view of the informal market than necessarily street people, prostitutes and peddlers. Our view corresponds to the ILO conception of a high economic potential of the informal sector.

Finally, the stylized fact of high internal migration in Africa, points at the existence of a high elasticity of substitution in consumption between formal and informal services. That is, a lower elasticity of substitution would not allow the expansion of informal sectors without producing a sharp decline in the price of informal services and, thus, of the informal sector real wage. This result, in turn, would ultimately reduce the flow of internal migration.

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[105] See Kouwenaar (1988) for a discussion of the meaning of the distribution parameter.

4.3.3.3 Migration Equations

Employment Probabilities by skill-migrant category

$$PBSS=\frac{TSSJ}{SUS} \quad [4.34]$$

$$PBSU=\frac{TSUJ}{0.92*SUS-TSSJ} \quad [4.35]$$

$$PBUU=\frac{TSUJ-SEU}{SUU} \quad [4.36]$$

where

PBSS=Probab. of skilled job in mod. sector for skilled

PBSU=Probab. of unskilled job in mod. sector for skilled

PBUU=Probab. of unskilled job in mod. sector for unskilled

TSSJ=Total number of skilled jobs in modern sector

TSUJ=Total number of unskilled jobs in modern sector

SEU=Total number of skilled workers in unskilled jobs in the modern sector

SUU, SUS=Total supply of unskilled and unskilled workers

Note: probabilities range between 0 and 1

Expected Nominal Wages by skill-migrant category

$$EWUI=PBUU*WUU \text{ or } EWUI=WULIS \text{ or } EWUI=LAG(WULIS) \quad [4.37]$$

$$EWSI=PBSS*WUS \text{ or } EWSi=PBSU*WUU \quad [4.38]$$

where

EWUI=Expected nominal wage for unskilled

EWSI=Expected nominal wage for skilled

WUU=Nominal wage for unskilled, modern sector

WUS=Nominal wage for skilled, modern sector

WULIS=Urban informal sector wage

Note: the relevant expected nominal wage will be the maximum among the possibilities available for each skill category.

Basic Urban-Rural Cost of Living

$$\mathrm{CLIVR}=\mathrm{BCFR}*0.8*\mathrm{PCF}+0.5*\mathrm{BCMFU1}*\mathrm{PC1}+0.5*\mathrm{BCMSU1}*\mathrm{PCS}+0.5*\mathrm{BCHU1}*0.08*\mathrm{WL7} \qquad [4.39]$$

$$\mathrm{CTLIVU}=\mathrm{BCFR}*\mathrm{PCF}+\mathrm{BCMFU1}*\mathrm{PC1}+\mathrm{BCMSU1}*\mathrm{PCS}+\mathrm{BCHU1}*\mathrm{PC3} \qquad [4.40]$$

where,

CLIVR=Basic rural cost of living

CTLIVU=Basic urban cost of living

BCFR, BCMFU1, BCMSU1, BCHU1, correspond to "social minimum quantities" of food, manufactures, services and housing in the LES demand system

PCF, PC1, PCS, PC3; final prices for food, manufactures , services composite, and housing-services.

WL7=value of the marginal product in small-farms

Real Expected Wage Differential Calculation

$$\mathrm{REWSI}=\frac{\mathrm{EWSI}*\mathrm{CLIVR}}{\mathrm{CTLIVU}*\mathrm{WA}}-1 \qquad [4.41]$$

$$REWUI=\frac{EWUI*CLIVR}{CTLIVU*WA}-1 \qquad [4.42]$$

where

REWSI=Skilled expected real wage differential

REWUI=Unskilled expected real wage differential

WA=Agricultural institutional wage

Calculation of Return Mobility Variable

$$WSUBU=12*PCF+6*PC3 \qquad [4.43]$$

$$LMOBU1=0.015+0.15*e^{-(WULIS/WSUBU)-1} \qquad [4.44]$$

where,

WSUBU=Critical urban subsistence wage

LMOBU1=Return mobility variable

WULIS=Urban informal sector wage

Rural-Urban Migration

$$MIGS=LMOBS*(REWSI)*RLS \qquad [4.45]$$

$$MIGU=LMOBU*(REWUI)*RLU \qquad [4.46]$$

where

MIGS=Net migration of skilled

MIGU=Net migration of unskilled

LMOBS=Mobility parameter for skilled

LMOBU=Mobility parameter for unskilled

RLS=Rural skilled labour stock

RLU=Urban unskilled labour stock

Return Migration

MIGS=LMOBU1*REWSI1*SUS*(-1) [4.47]

MIGU=LMOBU1*REWUI1*SUU*(-1) [4.48]

LMOBU1=Return mobility variable

Total Net Migration

MIGT=MIGS+MIGU [4.49]

4.3.4 Prices Block

The model treats several types of prices.

The world price is defined as the world-market dollar price of tradables. The model assumes that international transport costs are zero. These prices were denominated (PW1) for manufactures, (PWF) for agricultural goods and (PWM) for intermediate inputs.

The producer price corresponds to the sum of the input-output coefficients times their purchaser (or final) prices, plus the value added price times the value-added coefficient. This latter coefficient corresponds to the particular sectoral fixed proportion of value-added with respect to sectoral gross-output.

The final price or purchaser price, is the price faced by the consumer, as well as the price of intermediate inputs faced by the producer. It is convenient to remind that all goods and services in the model, except for housing-services, are used as intermediate inputs. This price incorporates indirect taxes and/or tariffs. The final price, thus, equals the producer price times, one plus the indirect tax. As well, the final price for the case of tradables will equal the product of the world price, the exchange rate and the tariff plus one.

It is easier to understand the meaning of the above prices through their mathematical expressions showed below,

Producer price:

$$PPi=PVi*(1-\sum_{j} aij)+(aij*Pj) \qquad [4.50]$$

where PPi=Producer price of good i

PVi=Value added price of good i

$(1-\sum aij)$=Value added coefficient

aij=Input of j, used per unit of i

Pj=Final price of j.

Final price or purchaser's price

$$PCi=PPi*(1+Ti) \qquad [4.51]$$

PCi=Final (purchaser) price of i

Ti=Indirect tax rate of i

In the case of manufactures, the final price is:

$$PC1=PW1*(1+TR1)*ER \qquad [4.52]$$

TR1=Tariff rate of i

ER=Exchange rate

i,j=1 (manufactures), 2 (modern services), 3 (housing-services), 4 (construction), 5 (informal services), 6 (big farms) 70, 71 (small farms), F (agriculture in general).

In the case of agricultural products, the final price is:

$$PCF=PWF*ER \qquad [4.53]$$

The most important price for us, however, is the value added price, which may be considered as the net-price received by the producer. This obtains by solving backwards the final price.

$$PVi=\frac{(Pci/(1+Ti)-aij*Pcj)}{1-\sum_{j}aij} \qquad [4.54]$$

The above equation shows how the tariff increases the value added price of manufactures. As well, it shows how indirect taxes on agricultural goods tend to squeeze the agricultural value added price. It is worth noticing, that this latter price is also squeezed by the effect of tariffs on its intermediate input price (manufactures inputs to agriculture).

Tradables supply in excess of domestic demand will be vented in the world market. It is worth noticing that exports of manufactures imply a reduction in its value added price, since they can be sold in the world market only at the world-price lower than the domestic one (converted in dollars).[106] In the case of non-tradables, by definition, there are neither exports nor imports.

The prices of non-tradables, housing services, informal services, modern services and construction (capital structures), are endogenously determined by supply and demand interaction. This interaction functions as follows. Supply, as discussed before, is decided in view of expected prices and expected profits. Thus, supply for the current period is "fixed". Then, the final price is obtained by the intersection of demand with this fixed supply.

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[106] This specification is similar to an Armington specification of exports. An Armington specification assumes that countries can export only certain share of the world market at the world price. In order to export more, the price must fall below the world price.

4.3.4.1 Price Expectations

Modern sector producers base their production decisions on expected value-added prices. The reasons for using these expectations were explained before. Basically, modern sector producers know that their actions affect prices, thus attempt to anticipate them in order to prevent abnormal loses and to maximize profits (Adelman and Robinson, 1978; Kouwenaar, 1988).

For all modern sector activities, except for modern services, the expected value added price (vap) was assumed to equal the average of the last two periods value added prices. This might be interpreted as an adaptative expectations mechanism, in which the forecast for the last period, constituted by its lagged price, is corrected by the actual value added price observed in the last period.[107]

The above expectations formation mechanism, however, would imply that modern services producers are myopic. Indeed, the most realistic outcome in this sector, is that a high relative value added price in a period will be followed by a strong fall in the next period and vice versa. Hence, modern sector services producers would tend always to be wrong in their expectations, making more profits in their original sector when allocating their investment to other sectors and vice versa.

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[107] This mechanism of expectations formations, does not rule out the possibility of forecasting a value added price greater than the one which actually obtains, though reduces this possibility, especially in the case of tradables.

This is a consequence of the ease of entrance of producers into the services sector relative to other urban sectors. This ease, in turn, is a consequence of the assumption that informal services constitute a good substitute of modern services and also of the more labour-intensive nature of the production techniques used by services.

Thus, expectations reflecting a more cautious attitude by modern services producers were specified. It was assumed that modern services producers would use initially the same expectation-formation mechanism as other modern sector producers. Though, they would review their expected price downwards, if it was higher than the resultant expected value added price for the average of the modern sector. In this case, they would assume this average as the expected price.[108]

4.3.4.2 The Demand Side

The demand specification used in this model corresponds to the Linear Expenditure System (LES).[109] The LES specification in general lines states that the consumption-unit (e.g. households, persons) allocates first, a part of its total expenditure to purchase the minimum consumption quantities of each good and service which are essential for a living. Second, the consumption-unit distributes the remainder of its total expenditure among different goods and services, according to its preferences expressed in the marginal-budget shares parameters, and the relative prices of these goods and services.

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[108] It must be said, that we looked for a compromise between economic theory and model-stability in the specification of mechanisms of expectations-formation. Some mechanisms were ruled out because they rapidly drove the model results to collapse, by imposing too sharp variations in supply. This was the case of e.g. assuming "myopic behavior". That is, assuming that the expected value added price was equal to the lag of the value added price.

[109] A succint explanation of the LES is provided in Taylor (1979).

The LES basic equation is the following:

$$Cij=(BCij+MRBij*\frac{(Ej-CEXj)}{PCi})*Lj \qquad [4.55]$$

where;

Cij=Aggregate real consumption
of good "i" by consumers "j";

BCij=Basic consumption of good i, per-consumer j,

MRBij=Marginal budget share of good "i"
for consumers j;

Ej=Total expenditure of consumer j

CEXj=Total committed expenditure per consumer j

PCi=Final price of good i

Lj=Aggregate of consumers j

i=1 to 6; 1=manufactures (MF), 2=services (MS),
3=housing (H); 6, 70, 71 (F)=food;

j=1,4; 1=peasants (R), 2=urban unskilled workers (U1),
3=urban skilled workers (U3) 4=capitalists (K),

A further clarification of these definitions is provided below.

Total expenditure (Ej) corresponds, initially, to the whole wage in the case of urban-workers. As mentioned before, urban workers do not save. In the case of peasants, it corresponds to its nominal consumption (CONSPE), which equals eighty percent of the institutional wage (WA).[110] Finally, in the case of capitalists it corresponds to its total nominal consumption (CK) defined before. Basic committed expenditure (CEXj) p/consumer, is equal to the sum of the "basic quantities" times its corresponding prices, for a specific category of workers.

Basic quantities (BCis) are interpreted here as minimum socio-economically determined quantities rather than literally subsistence quantities (Deaton and Muellbauer, 1980), as it is the case in some models (Mohan, 1984). The latter interpretation is too restrictive, leading to an unrealistic consumption specification. Specifically, it underestimates the minimum income required to live in the cities, and thus it exaggerates the individual convenience of internal migration.

In the model, the magnitudes of the basic-quantities (BCij) vary only between rural and urban consumers, but not among income groups. In particular, it was assumed that the BCis for housing, services and manufactures were zero for peasants. Only, the food basic quantity was assumed greater than zero and equal to the food consumption requirement in the city. In the urban areas all basic requirements were assumed to be greater than zero.

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[110] It is assumed that rural workers save 20 percent of the institutional wage. The assumption is arbitrary, though, it is based on World Bank and ILO information suggesting high rates of savings by peasants. See ILO(1972), Livingston (1986), World Bank (1975) and Killick (1981).

The marginal budget shares (MRBij) vary by income group. In determining their values, we followed stylized facts with respect to total-expenditure elasticities for different goods. For instance, we followed Engel's law with respect to food. In particular, it was assumed that for a relatively low standard of living society, the total-expenditure elasticity of food consumption may be close to one at the poorest level, to diminish fast as income rises. As well, it was assumed that all other goods and services except food have total-expenditure elasticities greater than one.[111]

In addition, in the determination of these parameters, the existence of dualistic patterns of consumption was considered. Specifically, it was assumed that urban consumers display stronger preferences for urban goods than food in comparison with rural consumers. It was also assumed that the "basic basket" of goods in the cities must be different from the basic basket in the rural areas.[112]

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[111] The designed LES system fulfills the Engel and Cournot aggregation conditions.

[112] In general, the values for the parameters were chosen in agreement with the scarce data from developing countries and Africa (LLuch et al., 1977; Kelley and Williamson, 1984; Anker and Knowles, 1983; Greer and Thorbercke, 1985). Some sensitivity analysis of these parameters was undertaken, specifically exaggerating the "luxury" character of urban goods. The results produced slightly more urbanization and growth of income per head. Exercises with too dissimilar parameters were not attempted.

The consumption-unit in the model is, in principle, the worker and the capitalist. Thus, minimum quantities and, in general, the demand behavior were specified assuming that the worker or capitalist consumption embodies the respective household behavior.[113]

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[113] It is worth noticing that the LES system has an important theoretical weakness in the fact that savings and, hence, total expenditure are exogenously determined. A substantial improvement upon the LES is constituted by the "extended linear expenditure system" (ELES), wherein savings become endogenous.

4.3.5 Production Block

4.3.5.1 Value Added and Gross-Output

The model considers both sectoral value added and gross output. Value added corresponds, by definition, to gross output minus intermediate inputs. It was assumed that the proportion of intermediate inputs to gross output, or the value added coefficient, would remain fixed over the whole horizon of the simulation.

$$VAi=(1-\sum_{j} aij)*GOi \qquad [4.56]$$

VAi=Value added in sector i

GOi=Gross-output in sector i

where i= MF1 (manufactures)
MS2 (modern services)
HS3 (housing-services)
MC4 (construction)
IS5 (informal-services)
BF6 (big-farms)
SF7 (small-small farms)
SF71 (small-medium farms)

Value added is generated by a production-function on the basic factors, capital and labour in urban activities, and capital labour and land in agricultural activities. These production functions were assumed to be Cobb-Douglas for all sectors. Gross output, in turn, keeps a Leontieff relation with intermediate-inputs. Thus, the solution of value added precedes the solution of gross output. This is obtained by dividing value added by the corresponding value added coefficient.[114]

$$aij=\frac{Xij}{GOi} \qquad [4.57]$$

where;

aij=Input-output coefficient. Amount of input from sector j, used per-output unit of sector i.

Xij=Total amount of input j, used in total production of i.

The sum of the different sectoral values added constitutes national income. Actually, GDP in the model was defined as the sum of all sectoral values added times their corresponding value added prices for the base year. Value added prices for the base year were defined as 1 (which might be considered as a price index or as an absolute price) for all sectors. Therefore, GDP constitutes basically a physical measurement, or in economic terms, a real variable.[115]

$$GDP=\sum_{i} VAi*PVi \qquad [4.58]$$

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[114] The initial value added figures approach the actual corresponding figures for Kenya in 1969. The information was obtained from Bachue-Kenya. The input-output coefficients, though, are similar to the ones used by Kelley and Williamson (1984) model of a representative developing country.

[115] Initial GDP comes close to the Kenyan GDP in 1969, measured in 1969 Kenyan pounds. The information was collected from Bachue-Kenya.

4.3.5.2 Sectoral Production Functions

Value added was modeled using Cobb-Douglas production functions with constant returns to scale, for all sectors. In the modern sector, the arguments for these functions are capital, skilled and unskilled labour, except for housing services which does not use labour. In the urban informal sector, the arguments are unskilled labour and capital. For agriculture, they are unskilled labour, capital and land.

Specifically, Manufactures, Modern services and Construction use capital (Ki), unskilled (Li) and skilled labour (LSi), in their value added production,

$$VAi=Ci*e^{TNi*t}*Ki^{SKi}*Li^{SLi}*LSi^{SLSi} \qquad [4.59];$$

where;

VAi=Value added;

i=denotes sector;

    1=Manufactures (MF1);

    2=Modern services (MS1);

    4=Construction (MC4)

Ci=Intercept;

TNi=Annual rate of neutral technological change;

t=Period t;

Ki=Sectoral capital;

Li=Sectoral unskilled labour;

LSi=Sectoral skilled labour;

SLi=Net-output elasticity of unskilled labour

(share in value added)

SLSi=Net-output elasticity of skilled labour

(share in value-added)

SKi=Net-output elasticity of capital

(*) means times

Housing services is produced with a combination of urban land and capital structures;

$$VAHS3=C3*e^{TNi*t}*KS3^{SKS3}*TUL^{STUL} \qquad [4.60]$$

where;

KS3=Capital structures

SKS3=Value added share of capital

TUL=Urban land

STUL=Value added share of urban land

Note: it is assumed that technological change in housing services is zero.

Informal services is produced combining unskilled labour and capital;

$$VAIS5=C5*L5^{SL5}*K5^{SK5} \qquad [4.61]$$

where,

VAIS5=Value added sector

C5=Intercept production function

SKS5=Value added share of capital

L5=Labour (informal) services

SL5=Value added share labour

Big and small farms value added are produced with Cobb-Douglas technologies combining unskilled labour (Li), capital (Ki) and land (TRi).

$$VAi=Ci*e^{TNi*t}Li^{SLi}*Ki^{SKi}*TRi^{STRi} \qquad [4.62]$$

where

i= 6 (BF6) big-farms, 70 (SF70) small-small farms

4.3.5.3 The Limitations of A Cobb-Douglas World

The original intention was to model some sectors production technology, by using CES production functions instead of Cobb-Douglas. This would have permitted the representation of situations in which the elasticity of substitution between labour and capital is different than one, e.g. higher than one for agriculture and lower than one for manufactures. [116] In sum, provided the latter situation is realistic, the use of Ces functions would have permitted a more elegant analysis of employment absorption in the modern sector, highlighting the problem of "inadequate" techniques in developing countries (Todaro, 1985).

The use of Ces functions was ruled out partly because of the excessive resultant number of parameters and the computational complexity implied by the use of these functions. On the positive side, however, the available data with respect to our hypothetical country adjusted better to

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[116] The intention was more ambitious, attempting a double-Ces production function for manufactures (Fallon and Layard, 1975).

Cobb-Douglas functions. In other words, the apparent easiness of substitution between labour and capital conveyed by a Cobb-Douglas relative to other production functions with elasticity of substitution lower than one, seems to be a realistic assumption for a low level of development economy.[117]

4.3.5.4 Technological Change

Technological progress, or change, shifts the production functions upwards or increase the ratio of output to productive inputs. Theoretically, all productive sectors are susceptible of experiencing technological progress. Nevertheless, according to African reality, low rates of technological change were assumed. Specifically, it was assumed a rate of eight per-thousand for manufactures and five per thousand for the big-farms. The other sectoral rates of technological change were assumed to be zero initially. However, these rates could be modified by institutional intervention.

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[117] The Cobb-Douglas adjusted better to the existing data on wages, and shares of wages and capital in value added, in Kenya than those suggested by the Ces functions (Anker and Knowles, 1983). A World Bank study of the Kenyan economy in 1975 also founds evidence in support of the Cobb-Douglas specification. Further, the elasticities of substitution values compatible with the data, for the Ces specification case, were too close to 1, rendering the use of this latter specification superfluous. Kelley and Williamson (1984), analysis of a representative developing country also arrives to values close to one for agriculture and manufactures in estimating these values. Finally, the modeling of Kenya undertaken by Swan et al. (1987), a team of Canadian development experts, uses as well Cobb-Douglas functions. Even though a justification for its use is not provided. The reality of the elasticity of substitution between labour and capital falling with development is discussed in Yotoupoulos (1976).

4.3.5.5 Labour Intensity Across Sectors

The modern sector uses capital intensive techniques while the informal sector uses labour intensive techniques. This implies that the elasticity of output with respect to capital in the modern sector is greater than the corresponding elasticity in the informal sector.

Capital intensity or labour intensity also differs within the activities of the modern sector. Manufactures and construction were modeled as the most capital intensive activities within the model. Modern-services was modeled as a fairly labour intensive sector in relation with the two previous ones, though, less labour intensive than informal services. Labour-skill intensity also differs among modern sector activities. On the informal sector, skilled labour is simply not used. Manufactures and construction were modeled as skill-intensive in relation to modern services.

4.3.5.6 Capital-Output Ratios

The initial capital-output ratios reflected the stylized facts of development. The highest was housing services (4.5), then construction (4), manufactures (2.5), services (2), and agriculture big-farms (2.2). The urban informal sector had a capital output ratio of 1.4, and the small-farms one of 1.1. [118]

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[118] These output-ratios come from a combination of sources, World-Bank (1975), Anker and Knowles (1983) and Swan et al. (1987).

The fact that housing and construction have a higher capital-output ratio than other sectors, can be used to argue that urbanization entails a cost in terms of foregone economic growth (Kelley et al., 1972; Kelley and Williamson, 1984; World Bank, 1975; Linn, 1983). In addition, urban housing standards have a connection with internal migration in the model. That is, lower housing standards, other things equal, by reducing the cost of living in cities would result in higher rural-urban migration.

4.4 Services Production and the Government

General equilibrium models, and, in general, economic-demographic models about developing countries scarcely incorporate the government sector. This omission constitutes a serious pitfall, since a great share of urban employment is generated by the government. Even most importantly, the educational expansion and health provision [119] in developing countries corresponds basically to government action. These variables, in turn, are of crucial importance in the modeling of demographic processes e.g. fertility, mortality and internal migration. [120]

There are alternative forms of modeling the government which entail different methodological advantages. [121] Specifically, the government was herein modeled assuming that the actual production of government services is left to the private sector, and that the government hires such a production at market determined prices. The produced services, in turn, are provided freely to the population which consumes or uses them. [122]

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[119] Indeed, the bulk of urban employment corresponds to government employment (Kelley et al., 1972).

[120] See Kelley et al. (1972).

[121] For instance, one alternative would be to treat the government as a direct producer of services through a production function. The demand for its services could be modeled by using a demand system e.g. the LES system. The main advantage of this specification is constituted by clarity e.g. with respect to government use of productive factors, labour and capital and by the clear tracking of the demand for these services. This type of specification, however, is insufficient to capture the bulk of services provided by governments in LDCs, e.g. administration which are of a less specific nature than health and education (Kelley, 1976).

[122] This specification resembles the one of Kelley and

Two sources of government demand for services: health and education, receive a more detailed treatment than its demand for other administrative services.

4.4.1 Educational Services

The educational component of the government demand for services is determined as follows. First, an approximate value for the total government expenditure on education in the basic year of the simulation was obtained. Second, the initial number of workers "either enrolled in or with primary education" was calculated through the multiplication of the primary school-enrollment ratio times the initial total of workers. Third, the total expenditure in education was divided by the previous figure to obtain the real cost of "educating one worker" in the base year.[123]

The expansion of real expenditure of education through time, assumed targets of primary school enrollment of 100 and 80 percent in urban and rural areas, respectively, to be achieved in a thirty year period. The initial school enrollment ratios were 65 and 35 percent for urban and rural areas, respectively. (Bigsten, 1984; Meck, 1971). Thus, the

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[122](cont'd) Williamson's (1984) model.

[123]It must be recalled, that the model just considers the population of workers; the rest of the population is implicit. Thus, the above real cost of "educating a worker" might be considered indistinctly as the cost of educating the children of the workers, or as an abstract index which attempts to relate population with government educational efforts. The former possibility, though, presents obvious demographic qualifications. The most important one relates to the evolution of the age-structure, absent from the modeling.

corresponding incremental rates of educational enrollment growth for urban and rural areas were determined as 1.43 and 2.75 percent annually, respectively. These are incremental rates, hence, the rates of growth of the respective populations, urban and rural, must be added to them in order to obtain roughly the rate at which the government expenditure in education expands. The point is reviewed in detail later.

This manner of modeling education replicates the actual history of Kenya, but, nonetheless, is common to some African countries. They have attempted to expand education rapidly since independence in the late 1960's, in an effort to reverse the colonial heritage of lack of skilled manpower (Unesco, 1969; World Bank, 1981).[124]

4.4.1.1 Education Expansion Equations

Two equations of real, rural and urban educational expenditure per-worker and one additional equation corresponding to total national expenditure in education are used in modeling education.

The rural and urban equations represent the following process. The primary school enrollment ratio is updated each period by the corresponding policy educational incremental rate. Then the updated school enrollment rate is multiplied by the initial real educational expenditure per capita. This gives the updated required real expenditure per-worker to increment schooling enrollment. The equation of national governmental expenditure in education, thus, transforms the previous per-worker results in total educational expenditure. As well, the result is multiplied by the price index, in order to keep and to increase educational expenditure in real terms. These equations are showed below:

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[124] The free or strongly subsidized provision of education and health has been essential in achieving the above goal. This is clearly illustrated, e.g. by the experiences of Kenya, Tanzania and Ghana displaying an impressive expansion of education, in which subsidization was crucial. On the other hand, the highest per-head income countries: Nigeria and the Ivory Coast, which relied on more market oriented polices pricing education at its real cost, display substantially lower educational records (World Bank, 1981; Fields, 1971).

$$GEDU=15*UPSE*e^{REDU*T}*PINDEX \qquad [4.63]$$

$$GEDEX=GEDU*(UP)+GEDR*(TRL) \qquad [4.64]$$

$$GEDR=15*RPSE*e^{REDR*T}*PINDEX \qquad [4.65]$$

where,

GEDU=Real educational expenditure per-urban worker

GEDR=Real educational expenditure per-rural worker

GEDEX=National real educational expenditure per-worker

REDU=Incremental rate of urban-primary school enrollment

REDR=Incremental rate of rural-primary school enrollment

UP, TRL equal urban and rural population, respectively

UPSE=Urban primary school enrollment, initial value

RPSE=Rural primary school enrollment, initial value

4.4.2 Health Services

Government expenditure in health follows a similar specification to education. The total government expenditure in health was calculated for the initial period. The total expenditure is updated annually by the rate of growth of the population, the national-policy rate of growth of health expenditure and the rate of inflation.

The resultant total expenditure is multiplied by the "urban bias" parameter and its complement, in order to obtain total urban and rural health expenditure, respectively. The "urban bias" parameter (ubias) is defined as the percent urban of the population plus ten percent. The complement is defined as one minus the urban bias.

The corresponding equations are the following:

$$GHEX=LAG(GHEX)*(1+LAG(NIR)+HPOL)*(1+IPC) \qquad [4.66]$$

$$GHEU=GHEX*\frac{UBIAS}{UP} \qquad [4.67]$$

$$GHER=\frac{GHEX*(1-UBIAS)}{TRL} \qquad [4.68]$$

where

GHEX=National expenditure in health

GHEU=Urban per-worker nominal expenditure in health

GHER=Rural per-worker nominal expenditure in health

UBIAS=Urban bias

UP,TRL are urban and rural sub-populations of workers

The remaining government demand for services, corresponds to an unspecified bundle of services. This keeps a direct relation with the size of total population and national income.

4.5 Housing Services and Rents

Housing services produce homogeneous units of housing for all urban consumers, using "urban land" and housing structures as inputs.[125] The existence of obvious housing-quality differentials by income and social groups is captured in the model by assuming greater housing marginal budget shares for upper income groups. Specifically, it was assumed that the marginal budget shares (mbsh) of housing services for skilled and capitalists was a little greater than the marginal budget shares for unskilled workers.

The model, does not consider rental differentials within the urban land. Central to our housing specification is the fact that the urban supply of land is regulated. The transformation of rural land into urban land is a government task, requiring the investment in urban infrastructure. Urban land was modeled to grow slowly, and thus urban rents grow rapidly (Kelley and Williamson, 1984).

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[125] Housing services are produced with a Cobb-Douglas technology which combines capital structures and land. The parameters for capital structures and land are 0.9 and 0.1, respectively. These data are based on Kelley et al. (1984) and Mills and Hamilton (1984)

It was also assumed that houses are rented from landowners which provide the housing services. This assumption is debatable on actual grounds and it must be considered mostly as a simplification to avoid modeling the savings-investment process leading to the purchase of a house. [126] In addition, it was assumed that the rent for urban-land is collected by the government, which uses it partly to undertake the expenses incurred in transforming rural into urban land (Shishido, 1983).

Finally, only urban housing services were modeled. The omission of an explicit treatment for rural housing services was based on the assumptions that rural-land rent for housing purposes may be considered zero, and that the "capital structures" used by peasants in the construction of their houses are sub-products of the land e.g. mud and hay. Thus, the final price for rural-housing may be considered negligible. This treatment, also enhances the fact of "basic cost" differentials between rural and urban areas. [127]

4.6 Agriculture

Agriculture is classified into two basic groups: small and big farms. The small farms sector is, in turn, subdivided in two sub-sectors, according to the size of land. This latter subdivision, however, was not fully developed theoretically; thus the primordial division within the rural sector is that between big and small farms.

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[126] The idea, was taken from Shishido (1983) model of dualistic development.

[127] This is particularly required in this model based on actual 1969 data for Kenya, where the nominal rural-urban wage differential is about ten times for unskilled workers, which exaggerates the real urban-rural wage differential.

4.6.1 The Subdivision of Small Farms

For most analytical purposes, the model collapses small-small and small-medium farms into one sector of small farms. Labor is allocated between the two groups of small farms by assuming "wage" equalization between them. That is, rural labour will shift between the two sub-sectors until the value of the marginal product between both is the same.

The model does not allow to disaggregate rural fertility and mortality by small-small and small-medium farms. In other words, both are assumed to have the same mortality and fertility. The model could disaggregate, however, the analysis of total migration by the two sizes of small farms.

The subdivision of small-farms into two sub-sectors was devised thinking of possible simulation experiments, for instance, to analyze the effect of different rates of technological change by farm size. Finally, the subdivision would permit a better approach to reality in our country type, where 80 percent of the households are peasants. The relevant factor in distinguishing among their economic and demographic behavior might be given by the size of owned land. For instance, in Kenya about a 30 percent of rural families inhabit plots of land too small to permit a minimal standard of living (Greer and Thorberke, 1985; Killick, 1981)

Finally, we have to provide some additional assumptions with respect to the peasants economic-demographic behavior. First, on grounds of simplicity, it was assumed that peasants pay the final price for food. Second, it was assumed that peasants work either exclusively on their farms or exclusively as wage-labourers on other farms. Third, peasants are assumed to act rationally, though, they display a strong solidarity behavior. [128] For instance, their migration decisions are based on rational grounds as it was explained previously. Fifth, transfers and urban-rural remittances were not considered in the determination of peasants' income, at least initially (Johnson and Whitelaw, 1974; Todaro and Rempel 1973; Anker and Knowles, 1983).

4.6.2 The Big-Small Farms Subdivision

Our relevant subdivision in agriculture between small and big farms corresponds to the Bachue-Kenya treatment (Anker and Knowles, 1983). We followed it in gross lines, basically due to the lack of consistency of other sources of data. [129]

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[128] Even though the value of the marginal product of labour is equalized among the different farm-sizes, each peasant receives the average farm product.

[129] Originally, we attempted to create an additional subdivision in the agricultural sector, between exports staples (coffee, and tea) and food production within the primary division of small and big farms, which would have allowed a more insightful treatment of demographic pressures. The data were scant, hence the attempt was abandoned.

The division between big and small farms corresponds to the distinction between the modern and the traditional sector, respectively. This classification, however, does not imply that the small-farms sector is not integrated in the market, or that this sector does not produce exports. For instance, in Kenya about 50 percent of the coffee exports are provided by the small farms (Livingston, 1986).

In principle, the model follows the assumption that the small-farms sector is economically more efficient than the big-farms sector. In this view, we followed the model of Swan et al. (1987) and the Bachue-Kenya model (Anker and Knowles, 1983). For the model, this means that the big-farms sector hires labour in a fixed proportion with land. Thus, the amount of labour hired in the big-farms sector will be economically efficient only by chance. On the contrary, in the small-farms sector labour is allocated between both small-farms sub-sectors in order to equate the amount of labour with the value of its marginal product.

The assumption of big-farms inefficiency has been widely debated, partly, because of its "political" implications in the sense of advocating land reform. In part, it has also been discussed because of adduced theoretical pitfalls, from the perspective of economics.[130]

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[130] An adamant argument favoring land reform is found in Bachue-Kenya. A defense of the big estates efficiency is presented in Killick (1981). A technocratic view of the debate is presented in Yotopoulos (1976). The political economy view on the issue is contained in Leys (1975).

The efficiency-issue debate is unsettled, and it will not be reproduced here. Nevertheless, we assume a cautious position on it. On the one hand, it is everywhere demonstrated that the small-farms sector uses more labour-intensive techniques. Hence, land-reform might constitute perhaps the only solution to rural underemployment. Though, this does not mean necessarily that the small farms sector is per se more economically efficient than the big-farms sector. It may indicate, for instance, that the small-farms sector faces a lower relative price of labour due to the use of family-labour. In addition, in the big farms sector, the existence of both efficient and inefficient producers is clear. [3]

In conclusion, we assumed a cautious position with respect to the possibilities of evaluating land-reform, because the issue is not that clear theoretically and the low level of disaggregation and scant information on this model was too incomplete for such an assessment.

A final crucial difference between the small and the big farms was constituted by their different rates of technological change. It was assumed that, in the absence of government intervention, the rates of technological change are greater in the big-farms sector than in the small-farms sector.

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[3] For instance, there is no reason to assume that big estates oriented to exports must behave inefficiently. Other form of big-farms, however, might represent land tenure for speculative-investment purposes. In addition, the reason why big-farms appear to hire labour in a fixed proportion with land may be due to a substantially reduced elasticity of substitution between capital and labour in this sector.

4.6.2.1 The Growth of Agricultural Land

The growth of rural land was assumed to behave differently for small and big farms. Land in big farms was assumed to grow exogenously at a rate of 3 percent annually until its reserved land is over, approximately 17 years. Land in small farms was assumed to grow at a similar rate to the rural rate of population growth, until its reserved land is over. The total amount of land and its distribution corresponds approximately to the Bachue-Kenya data (Anker and Knowles, 1983).

In general, this form of modeling the growth of rural land assumes the incipient stage of agricultural-land markets in African economies. Hence, it gives a role to the government in land allocation and distribution in order to replace the absence of a land market.[132]

In particular, the assumption of an exogenous rate of growth of big-farms land was based upon the Kenyan government actual behavior with respect to the growth of land for exports staples (Swan et al., 1987). The assumption with respect to the growth of land for small-farms reflects the past government behaviour to accommodate peasant population within the country land. [133]

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[132] Leys (1975) has documented the efforts by the Kenyan government to create this market, amidst political struggles of the peasantry, white settlers and an incipient native bourgeoisie. This form of modeling land growth, thus, reflects a more realistic situation which can be generalized to whole Africa. See also Killick (1981).

[133] This behaviour was mostly due to the peasant character of

4.7 The Demographic Side of the Model

The model treats only the sub-population of workers. It is time to examine the implications of having omitted the treatment of the whole population in the model.

The lack of modeling of the whole population was due to time constraints. Nevertheless, its omission does not affect the analytical insights obtained. In other words, the use of a sub-population of workers permits the reproduction, albeit in an abstract form, of the relevant aspects of the population and economic-development interaction. For instance, it is possible to analyze underemployment, Malthusian pressures, poverty, perpetuation of a high fertility regime, effects of an explosive population growth on economic growth, internal migration and urbanization.

The model was interested in highlighting macro interactions between population and economic development, rather than in reproducing a mechanistic accounting of the population evolution in our country type, which is usually the case in models which disaggregate by age-sex structure. Hence, the importance of population in the model relates to the manner in which its construction permits a highlighting of such macro interactions. For instance, the demand parameters will differ by rural-urban location, highlighting the connection between migration and relative prices. The institutional rule determining modern wages was designed to

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[133](cont'd) the national uprising leading to independence. This behaviour, though, has been clearly limited by the government attitude to respect big-land and white settlers (Killick, 1981).

present the most likely situation of a relative surplus labour economy.

4.7.1 Assessment of Possible Misspecification

In any event, it is convenient to assess the possible misspecifications caused by our treatment of a sub-population of workers upon the main demographic processes treated in the model.

4.7.1.1 The Analysis of Internal Migration

The analysis of internal migration is fairly complete in relation to other economic-demographic models. [134] True, this is a migration of workers, and the engine driving migration is mostly constituted by economic reasons. Nevertheless, there seems to be a consensus that both elements constitute the theoretical bulk in the analysis of internal migration. [135]

In addition, the expansion of the migration analysis to the whole population, in most models, seems to constitute basically a mechanical exercise. In general, migrants by age-sex group are obtained from the application of fixed coefficients to the core result of migration of workers.[136] What our model misses in the analysis of internal migration are instances where age and/or sex might achieve a more autonomous theoretical role in determining internal migration. This, unfortunately, might happen in Africa, where the sex ratios in the cities are sharply unbalanced, suggesting particular theoretical elements in explaining female inmigration. For instance, the high preponderance of males in the cities suggests a particular specification of lagged female inmigration (Todaro and Thadanni, 1978; Pool, 1971).

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[134] A review of the most important economic-demographic models of the last twenty years was provided in chapter three.

[135] For a complete overview see either Todaro (1980), Yap (1977) or Williamson (1988).

[136] For an example of this procedure see the United Nations-ESCAP (1988) economic-demographic models for Asia.

4.7.1.2 Fertility and Mortality

The model permits an analysis of fertility and mortality as means to simulate the rise and decline in the rate of population growth. Most importantly, it permits one to analyze the effects of the evolution of the above rate upon economic variables such as employment, economic growth and so on; and its feedback on the demographic variables. As well, it permits a stylized or abstract treatment of fertility and mortality in themselves. This treatment is, however, indirect but it suffices to fulfill our ultimate analytical purposes.

Specifically, the evolution of the rate of increase of our population of workers through fertility and mortality might be interpreted in two manners. A literal interpretation means that the labour force increases at the same rate than that of the population. This interpretation, however, would soon entail theoretical problems, for instance, when dealing with consumption. Thus, we prefer a less literal interpretation. In this reading, the demographic behaviour of the population of workers, provided certain qualifications, indicates the demographic behaviour of the total population.

4.7.1.3 The Lack of Age Structure on Savings, The Participation Rate on the Labour Force and Government Expenditure

The most important qualification to our treatment of the population, is the lack of age-structure economic-demographic interactions. Fortunately, these interactions seem to be most important for developed countries rather than for developing countries.

Indeed, the age-structure has proven to have a negligible relation to consumption, savings and governmental expenditure in developing countries. The reasons for this outcome, some of them mentioned before, are the following. Families in developing countries are too poor in order to save more when the number of children is reduced. In this case, only individual consumption of the family members will increase (Gupta, 1975, 1982). In short, savings in developing countries have little to do with family demographics. Rather it is the behaviour of enterprises which seems unrelated to the latter (Bilsborrow, 1973, 1977). The age-structure is minimally related to government expenditure in developing countries. The reason seems to be that Third World countries are simply too poor to care (Cassen, 1973; Stone, 1973). Of more important concern to our modeling is the relation between the dependency rate and labour participation. In developing countries, however, most of the population must work from an early age, a phenomenon which lasts until the development process is well advanced. Thus, the relation between the age structure and the labour participation rate is not necessarily inverse, as the literature on age-structure economic effects might suggest (Bilsborrow, 1975; Durand, 1973).

In sum, the above discussion suffices to provide a context to judge our omission of the whole population in the model.

4.7.2 The Unpredictability of African Demography: A Modeling Dilemma and Theory

The future evolution of the rate of population growth in Africa, to a certain extent, constitutes a dilemma upon which few predictions have proven to be accurate.[137] The theoretical underpinnings of this uncertainty were largely discussed in chapter two, thus they will not be repeated here. As mentioned before, this uncertainty is reflected in e.g. the fact that fertility has been resilient to decline in spite of a fall in infant mortality, and that modernization advances have sometimes produced increases in fertility (Cantrelle et al., 1978; Morgan, 1976; Romaniuk, 1978; Caldwell, 1976, Gomes, 1984; Boongarts et al., 1984; United Nations, 1987). Furthermore, not even the upper limit of the crude birth rate, given its natural limitation, is that clear in Africa.[138]

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[137] See Frank and McNicoll (1987), who analyze the rise of fertility of Kenya, in spite of predictions that it would have started declining twenty years ago.

The above illustrates some of the difficulties involved in simulating African demography if one wants to achieve an acceptable degree of realism. A simulation must have a well rooted theory underlying it which is apparently lacking in the African case.

4.8 The Modeling of Fertility and Mortality

In view of the above mentioned theoretical uncertainty regarding African fertility, we have developed a flexible theoretical framework to model fertility. That is, a main theoretical proposition of African fertility is modeled together with alternative specifications. The validity of each theoretical approach to fertility is tested through simulation analysis, by comparing its simulated economic-demographic time path with the actual economic-demographic time path of the economy modeled during 1970-1990.

The main modeling proposition used here is theoretically rooted on Caldwell's (1976) theory of fertility and Easterlin and Crimmins (1985) perspective of supply-demand fertility determination at low levels of development. It is also rooted on political-economy views of fertility which stress pension-motives in explaining high fertility in developing countries (Greenhald, 1990).

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[138] Romaniuk (1969, 1978), who researched the positive impact of development on fertility for Francophone African countries, states that the crude birth rate of some of these countries could have risen to levels of 57-60, provided a continuation of governmental health-efforts in controlling malaria and venereal diseases.

In essence, this proposition assumes that high fertility prevails in rural areas because it is rational to have large families in a peasant economy. Modernization in the form of health and nourishment improvements raises initially fertility (Romaniuck, 1978; Bongaarts et. al., 1984). Other cultural changes associated with modernization such as the shortening of the breast-feeding period and the relaxation of post-partum sexual abstinence also raise fertility (Bongaarts, 1986). The breakdown in the rationality for high rural fertility can be achieved only if the peasants experience a minimum significant welfare improvement. After this critical welfare level or developmental threshold, rural fertility will start declining according development proceeds. In other words, fertility will become demand determined (Easterlin and Crimmins, 1985).

In urban areas, and in rural areas after the threshold level, development affects fertility negatively. The indicator of development used in this theoretical proposition is the weighed sum of life expectancy, adult education and the real wage rate. The effect of the latter variables on fertility is the conventional one in the literature of the economic determinants of fertility (Birdsall, 1977, 1979).

That is, life expectancy as a proxy for infant mortality affects fertility negatively. The real wage rate as a proxy for the value of time in a dynamic framework also affects fertility negatively. Finally, education also affects fertility negatively. In the model, education is measured by the proportion of skilled workers within the respective labour force (urban or rural). The use of this variable instead of educational expenditure is due to the attempt of proxying secondary rather than primary education level. Indeed, only secondary education has a negative effect on fertility in Africa (United Nations, 1987, Arowolo, 1976). The general assumption of a lower urban than rural fertility in Africa, especially in Kenya, is well substantiated on both theoretical and empirical grounds (Arowolo, 1976; World Bank, 1980; Anker and Knowles, 1982, 1983). Finally, this proposition assumes that tastes in favour of big families decline through time in urban areas (Freedman, 1978, 1982).

The concept of a welfare threshold in rural areas may be crucial in the model results associated with this theoretical proposition. In particular, the higher the threshold level the lower will be the decline in total fertility produced by socioeconomic development in the modeled economy.

Unfortunately, it is impossible to know what that level might be. For instance, the work associated with Bongaarts (1986) stating that African fertility has a vast potential to rise, suggests a fairly high threshold level. Birdsall (1980) suggests that most people in developing countries are at the right of this threshold except for Africa. The empirical work in Kenya, in general, has estimated interaction or quadratic effects of isolated variables, e.g. education and infant mortality on fertility pointing to the existence of a general threshold. However, it has not been concerned with measuring this more general proposition (Anker and Knoles, 1982, 1983; Anker, 1985; World Bank, 1980). Therefore, we assumed an arbitrary level for the threshold and tested through simulation analysis the feasibility of such a level and of the very existence of a threshold level at all.(3)

Alternative theoretical propositions of fertility were done with the purpose of assessing this main theoretical proposition. In simple terms, the most important alternative proposition states that fertility is a nonlinear negative function of income per capita. That is, fertility declines at a decreasing rate as income per capita increases until eventually reaching a low asymptote. The justification for this proposition was discussed in chapter two. In essence, income per head can be seen as proxying modernization and/or collapsing indirect and direct effects of income on fertility.

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(3) The threshold was assumed to equal 1.3 times the initial value of the Cobb-Douglas function combining the real wage, education and life expectancy.

Finally, another fertility specification combining the above two fertility specifications was done. In this specification, rural fertility is assumed to be positively affected by health advances and food consumption until a threshold defined in terms of income per capita is reached.[140] Thereafter, rural fertility behaves as in the second fertility specification above. That is, it declines as income per head rises. Urban fertility is simply assumed to decline as income per head rises.

These three fertility specifications are used to assess the existence of a nonlinear relation between rural fertility and socioeconomic development, and to gain insight with respect to a correct specification for African fertility.

4.8.1 The Demographic Equations

Below, there are explained in detail only the equations corresponding to the main theoretical proposition (specification) of fertility. The second and the third fertility specifications are extremely simply, thus, their explanation above should suffice. The mortality specification is common to the three fertility specifications.

Fertility is measured by the crude birth rate, mortality by the crude death rate. The difference between the two gives the rate of natural increase. The model also endogenizes life expectancy at birth.

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[140] The threshold level was established as 1.3 times the initial level of income per capita.

In the urban areas developmental advances experienced by the population affect fertility negatively. These advances are defined as real wage increases, educational and life expectancy improvements. Modernization of values in urban areas change attitudes from an initial desire for larger families toward smaller families. This change occurs at a constant annual rate through time.

In the rural areas, developmental advances initially affect fertility positively. Specifically, at this stage, the crude birth rate is postulated as a positive function of life expectancy and food consumption. The crude birth rate function is also shifted upwards annually at a constant rate which captures modernization and/or medical progress effects on raising fecundity and the level of fertility exposure.

The high fertility regime ends when a developmental threshold is reached. This threshold was set up at approximately 1.3 times the initial Cobb-Douglas combination of variables, used to determine fertility. Beyond this level, the rural population enters into a fertility regime similar to the one prevailing in the city. The impacts (coefficients), however, of the independent variables upon rural fertility are not necessarily equal to the corresponding impacts on urban fertility. As well, changing attitudes toward family-size are modified at a slower rate than in the cities.

In sum, in urban areas, and in the rural areas once the threshold has been surpassed, fertility is assumed to be a negative function of the real basic wage, the skilled ratio of the labour force and the lag of life expectancy at birth. Changing attitudes toward smaller family size are represented by the annual shift of the fertility function at a constant rate. This rate is higher for urban than for rural areas.

The real basic wage is defined as the nominal wage divided by the cost of a basic basket of goods and services. The basket is different for rural and urban areas. The concept is the same as the one used in the specification of internal-migration. The skilled ratio is the ratio of skilled workers to the corresponding, rural or urban, labour force. The skilled ratio is a variable which proxies the educational level of the population in the model. That is, a rise in the skilled ratio in the cities means that the educational level of the urban population has risen and vice versa.

Specifically, the crude birth rate is determined as follows. A Cobb-Douglas function combines the real basic wage, life expectancy, and the skilled ratio as arguments to obtain a proxy for the standard of living. The constant of the function increases through time at a constant rate, capturing modernization attitudes tending to a reduction in the family size. The result of the Cobb-Douglas function divides, in turn, a positional parameter. This resultant whole expression is added to an assumed lower asymptote of the crude birth rate, giving the crude birth rate for the period.

Basically, this function tells that as development proceeds fertility will decline at a declining rate converging to an asymptotic low level. Most importantly, the function provides a useful form of measuring tangible development benefits experienced by the people, and of separating among different causal effects. Thus, it permits more realism in the analysis since the effect of any of the included variables in the function, on fertility, depends among the level of the other variables. For instance, a deterioration in the real wage will reduce the negative impact on fertility of educational expansion.

Two versions of the Cobb-Douglas function were used. The first version assumes increasing returns to scale. That is, the sum of the parameters is greater than unity. The wage variable, in this version, is the average between the current and the last period wage. The second version assumes constant returns to scale. That is, the sum of its parameters equals unity. In addition, in this version, the wage variable is the current wage. The results analyzed correspond to the first version, due to the unreal results of the second one.

4.8.1.1 Fertility Equations

The urban crude birth rate (CBRU) equation follows:

$$\mathrm{CBRU}=\frac{\mathrm{BIRTHU1}}{\mathrm{COBFU}}+\mathrm{BIRTHU2} \qquad [4.69]$$

where;

CBRU=Urban crude birth rate

BIRTHU1=Positional parameter

COBFU=Cobb-Douglas fertility determinants

BIRTHU2=Lower CBRU asymptote

$$\mathrm{COBFU}=e^{\mathrm{TSBU}*\mathrm{T}}*\left(\frac{\mathrm{WURB}*\mathrm{CTLIVU}_0}{\mathrm{CTLIVU}_\mathrm{T}}\right)^{\mathrm{BUW}}*(\mathrm{LAG}(\mathrm{LEBU}))^{\mathrm{BUL}}*(\mathrm{SKILU}*100)^{\mathrm{BUE}} \qquad [4.70]$$

where;

TSBU=Rate of change of anti-fertility tastes

T=time

e=number e

WURB=Urban wage

CLIVU=Urban cost of living

LEBU=Urban life expectancy

SKILU=Urban skilled ratio

BUW, BUL, BUE are Cobb-Douglas impact coefficients

The rural crude birth rate below the threshold is:

$$\mathrm{CBRR}=\mathrm{NFERT}-\frac{\mathrm{COF1}}{e^{\mathrm{T}*\mathrm{MTR1}}*\mathrm{LAG}(\mathrm{LEB})^{\mathrm{FR3}}*\mathrm{FPES}^{\mathrm{FR4}}} \qquad [4.71]$$

where

CBRR=Rural crude birth rate

LEBR=Life expectancy at birth

FPES=Rural per-worker real food-consumption

NFERT=Upper rural crude birth rate asymptote

FR3 and FR4, parameters

MTR1=Rate of change of fecundity constraint

The crude birth rate equation above the threshold follows:

$$\mathrm{CBRR}=\frac{\mathrm{BIRTHR1}}{\mathrm{COBFR}}+\mathrm{BIRTHR2} \qquad [4.72]$$

$$\mathrm{COBFR}=e^{\mathrm{TSBR}*\mathrm{T}}*\left(\frac{\mathrm{WA}*\mathrm{CLIVR}_0}{\mathrm{CLIVR}_\mathrm{T}}\right)^{\mathrm{BRW}}*(\mathrm{LAG}(\mathrm{LEBR}))^{\mathrm{BRL}}*(100*\mathrm{SKILR})^{\mathrm{BRE}} \qquad [4.73]$$

CBRR=Rural crude birth rate

BIRTHR1=Positional parameter

COBFR=Cobb-Douglas fertility determinants

BIRTHR2=Lower CBRR asymptote

$$\mathrm{COBFU}=e^{\mathrm{TSBU}*\mathrm{T}}*\left(\frac{\mathrm{WURB}*\mathrm{CTLIVU}_0}{\mathrm{CTLIVU}_\mathrm{T}}\right)^{\mathrm{BUW}}*(\mathrm{LAG}(\mathrm{LEBU}))^{\mathrm{BUL}}*(\mathrm{SKILU}*100)^{\mathrm{BUE}} \qquad [4.74]$$

where;

TSBR=Rate of change of anti-fertility tastes

T=Time

e=Number e

WA=Agric. wage

CLIVR=Rural cost of living

LEBR=Rural life expectancy

SKILR=Rural skilled ratio

BRW, BRL, BRE are Cobb-Douglas impact coefficients

The asymptote for urban fertility was assumed to be 18, corresponding to a crude birth rate (CBR) level associated with highly developed Third World countries (Uruguay). The rural lower asymptote was assumed to be 24, with a similar criterion. The difference in slopes and asymptotes, reflects the fact that rural fertility is more resilient to decline than urban fertility, with respect to advances in development.

4.8.1.2 Mortality Equations

The crude death rate construction is as follows. A Cobb-Douglas using food consumption per worker, the real basic wage, the skilled ratio of the labour force and government real expenditure in health per worker, as arguments, measures a sort of health product. The constant term of the Cobb-Douglas increases annually at a constant rate due to technological health or medical progress. The resultant value of the Cobb-Douglas, the health product, divides a parameter. The whole resultant expression is added to a lower asymptote for the crude death rate. It was specified also that the mortality asymptote is reduced by technological medical advances.

Life expectancy is derived from the same variables determining the crude death rate. Actually, it constitutes a transformation of the latter, which approaches loosely the reciprocal of the crude death rate defined in per thousand terms. The transformation was calibrated to produce realistic results.

The lower asymptote for the urban crude death rate was assumed as 6. The lower asymptote for the rural crude death rate was assumed as 10.

The equation for the urban crude death rate follows;

$$\mathrm{CDRU}=\frac{\mathrm{DETHU1}}{\mathrm{COBLU}}+\mathrm{DETHU2} \qquad [4.75]$$

$$\mathrm{COBLU}=e^{\mathrm{MTU}*\mathrm{T}}*\mathrm{FURB}^{\mathrm{DUF}}*\left(\frac{\mathrm{WURB}*\mathrm{CTLIVU}_0}{\mathrm{CTLIVU}_T}\right)^{\mathrm{DUW}}*\left(\frac{\mathrm{GHEU}}{\mathrm{PINDEX}}\right)^{\mathrm{DUH}}*(\mathrm{SKILU}*100)^{\mathrm{DUE}} \qquad [4.76]$$

where,

CDRU=Urban crude death rate

DETHU1=Positional parameter

DETHU2=Lower urban crude death rate asymptote

COBLU=Cobb-Douglas determinants of urban mortality

DUF, DUW, DUW, DUH=Cobb-douglas impact coefficients

MTU=Rate of urban medical technological change

FURB=Food consumption per-urban worker

WURB=Urban average wage

CTLIVU=Urban cost of living

GHEU=Nominal per capita governmental health expenditure

PINDEX=Price index

CTLIVU=Basic cost of living

The rural crude death rate has the same generic design, and thus is not presented here.

The specifications of mortality and fertility and the initial socioeconomic conditions in the model, imply the existence of rural-urban differentials for both mortality and fertility. These differentials by the model construction will persist in time, reflecting the actual existence of rural-urban demographic gaps, reported elsewhere. These gaps might widen or become closer to a lower limit, given by the asymptotes of the respective curves, depending on the course of the endogenous forces modeled.

Finally, the differential in rural-urban mortality was modeled assuming a general nonlinear relation between mortality and the health product (Preston, 1980, 1985). That is, it was assumed that exogenous measures had a greater impact in reducing rural mortality than in reducing urban mortality, until certain limit. This is due to the fact that rural mortality is initially at a such high level, that exogenous measures have a great impact on reducing it. Urban mortality much lower than the rural one, is at an stage which can be reduced mostly by improving the standard of living. These mortality-reduction features were captured also by assuming a higher rate of rural than urban medical technological change.

5. BASIC SIMULATION CASE : THE DEVELOPMENTAL TIME PATH

1970-2000

Introduction

The model attempts to replicate and simulate the structural and demographic changes of the stylized economy over the period 1970-2000. The correct replication of the historical pattern of development and demographic change of the stylized economy is crucial in order to use the model in further policy analysis. That is, such a replication constitutes the validation test of the model specification and specifically of its economic, institutional and demographic assumptions.[4]

The modeled economy incorporates economic-demographic features similar to the ones of eight African countries: Zaire, Kenya, Tanzania, The Ivory Coast, Nigeria, Zimbabwe, Ghana and Sudan. A key feature in analyzing this particular group of countries was according to the World Bank, their tendency to generate an explosive rate of population growth (Faruqee and Gulhati, 1983). The ultimate purpose of using a group of countries was to achieve certain degree of generality with the model with respect to the analysis of the Sub-Saharan "population problem".

The stylized economy modeled, however, may not be a representative Sub-Saharan African country. In fact, these countries present important differences among themselves. Specifically, the stylized economy will resemble mostly Kenya's economic performance, migration and fertility trends. Some other characteristics e.g. mortality will resemble more the average of the above group of countries. [142]

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[4] This replication is essential in this model, given that the parameters of the equations constitute educated guesses based on a combination of theory and available empirical evidence and were not tested in the traditional statistical sense.

The chapter is organized in two main sections. In the first one, we undertake sensitivity analysis of the model's capability in replicating the pattern of development and demographic change of the stylized economy under different fertility specifications. The fertility specification which produces the most comprehensive replication of the afore mentioned pattern is chosen for much of the analysis to follow. In section two, the replication achieved by the model with the chosen specification, is discussed in more detail. It is also explained why the model reproduces the developmental pattern which is crucial for understanding the policy analysis undertaken in chapter six.

5.1 Sensitivity Analysis of Fertility Specification

The sensitivity analysis undertaken permits to determine the extent to which different specifications of fertility produce departures from the stylized pattern of development and demographic change. To the extent that the departure is extreme and/or the developmental pattern generated is inconsistent with the stylized facts, one can disregard the corresponding specification for policy analysis purposes. In addition, as suggested before, the sensitivity analysis constitutes, indeed, the actual validation test for our basic model specification.

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[142] Most of the data used to calibrate the model, however, correspond to Kenya. Hence, the modeled economy will resemble mostly this country economic and demographic potential.

The analysis is centered around two theoretically plausible fertility specifications and an intermediate version of both. It was centered around these specifications because they could lead to different policy assessments. The details of these specifications were provided before in chapter two and five.

In essence, the first fertility specification assumes that fertility above a developmental threshold is a negative function of life expectancy, the real wage rate, adult education and time giving account of modernization effects on fertility tastes. Below this threshold, fertility is a positive function of life expectancy, food consumption and time. The latter gives account of modernization effects relaxing traditional taboos regulating fertility. The rural population is assumed to be initially below this threshold level. The threshold level is achieved when a weighed sum of the rural real wage rate, life expectancy and education rises to 1.3 times[143] The threshold may not be achieved if the rural wage is stagnant, and/or life expectancy and education do not rise sufficiently. Education, is measured by the percent of skilled workers within the labour force (rural or urban).

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[143] This value is arbitrary. Indeed, there is no way to know what this threshold value really is. See Birdsall (1980) and Easterlin and Crimmins (1985). For more details see chapter four.

The second fertility specification assumes that fertility in both rural and urban areas is a negative function of income per head. Specifically, fertility declines nonlinearly as income per head rises until converging eventually to a lower asymptote. This specification may be viewed as capturing the total effect of income on fertility or simply proxying modernization.[144] In this specification, we assumed an elasticity of fertility with respect to income per head akin to international cross-country evidence, certainly, greater than the one suggested by African and/or Kenyan evidence.

The intermediate fertility specification assumes that rural fertility is positively affected by life expectancy and food consumption before a threshold level of development, and negatively affected by income per head after this threshold. The threshold level is reached when income per head rises 1.3 times. The elasticity of fertility with respect to income per-head is similar to the one suggested by Bachue-Kenya. The specification of urban fertility is the same as in the previous case. As it can be seen, this specification is a clear combination of both previous specifications.

The first two fertility specifications are not entirely dissimilar. Indeed, both of them describe a relation between income per-capita and fertility. Although, in the first specification this relation is implicit. [145] Specifically, in this specification, aggregate or national fertility may present a slightly inverted u-shaped relation with income and/or a mild negative relation. In simple terms, in the second specification fertility presents a negative causal relation with income per head with a steeper slope. It is important to keep in mind, thus, that the sensitivity analysis below between the two main fertility specifications constitutes a test of the income-elasticity of African fertility to a certain extent.

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[144] See chapter two and chapter four.

Common Assumptions in the Three Basic Cases

The following are the most relevant assumptions common to the three basic reference cases. Technological change in manufactures and in the big farms sector proceeds at annual rates of 0.8 and 0.5 percent, respectively. The other sectors do not experience technological change.

Land in the big farms sector grows at an annual rate of 3 percent, from initial 1236 (000) hectares until reaching 2042 (000) hectares. Land in the small farms sector grows at a rate equal to 90 percent of rural natural increase, from initial 3679 (000) hectares until reaching 4628 (000) hectares. Land becomes unavailable for agricultural use when these limits are reached.

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[145] That is, increases in income should raise ultimately the wage rate, life expectancy and other variables which affect fertility negatively. However, the course of the latter variables might lag, or differ, for several reasons from the course of per-capita income, thus, the fertility trajectory arising from both specifications may differ substantively.

The Kenyan terms of trade 1969-1987 were used to calculate the prices for the tradables in the first 19 years of the simulation. The remaining 11 years were obtained by a linear forecasting based upon the previous 19 years data. [146]

The government health policy is to expand real health expenditure per head at an annual rate of 2 percent. Urban areas receive a share equal to the percent urban of the population plus ten percent, of the national expenditure in health. Rural areas receive the complement. The government educational policy is to increase real expenditure per head in education at an annual rate of 2.7 percent in rural areas, and 1.4 percent in urban areas. Urban areas display initially a greater expenditure per head in both education and health.

Analysis of The Results

In table 5.1[147] , there are displayed the results of the basic reference cases using the three different specifications of fertility. These cases will be denoted BCASE1 for the first fertility specification, BCASE2 for the intermediate fertility specification, and BCASE3 for the second fertility specification.

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[146] The terms of trade (1969-1987) are the following: 95.8, 91.7, 81.6, 97.2, 104, 104.4, 97.4, 114.4, 136.1, 107, 107, 100, 92.3, 90.1, 94.1, 103.8, 91.9, 111.6, 87.1. The simulations, however, kept the same terms of trade of the year 1969, for 1970 to 1972.

[147] All tables used in the analysis are located at the end of the section.

Let us look, first, at common features reproduced by these specifications which can be associated with the distinct developmental pattern of the region described in chapter one.[148]

First, the three cases depict a situation of increasing external indebtedness. The foreign debt as a percentage of GDP ranges from 95 percent in the third case to 120% in the first case. The actual external debt for the average of these countries grew actually from 16 percent of GDP in 1970 to 84 percent in 1987. Some of them, e.g the Ivory Coast and Nigeria, already achieved an accumulated debt equivalent to 124 and 111 percent of GDP in 1987, respectively (World Bank, 1989, 1992). Thus, the depicted range of the debt by the three cases is realistic.

Second, in all cases there is a decline in agricultural production per head. The index of food per capita production in the year 2000 (with base 100 in 1970) ranges from 76 to 93. The variation is explained by the different rates of growth of per capita income. This distinctive characteristic of Sub-Saharan countries has been reported elsewhere in the literature (Faruqee and Gulhati, 1983; World Bank, 1981, 1984).

Third, the three cases generate a high rate of growth of urban areas in the range of 6 to 7 percent driven to a great extent by rapid rural-urban migration. The phenomenon of rapid growth of urban areas and rapid internal migration constitutes a distinctive feature of Eastern Africa pattern of development (United Nations, 1988; Livingston, 1986; ILO, 1972; World Bank, 1980). The actual average rate of growth of urban areas for the average AFS (selected African countries), during the period 1970-82 was 6.7 percent, and for the period 1980-87 was 6.8 percent.[149]

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[148] The causal explanation of these events is postponed to the next section.

A fourth important common feature is the decline in real wages which takes place more markedly in urban areas. This fall in real wages seems to have actually taken place in most Sub-Saharan countries during the last twenty years and specifically in Kenya (Wanatabe, 1976; Bloom and Freeman, 1987; Anker and Knowles, 1983). [150]

These features portray in general lines the Sub-Saharan African scenario illustrated in Chapter one. True, the competing fertility specifications produce differences in the intensity and/or levels of some of the phenomena mentioned above, however, the essence of these phenomena is not altered. These differences are a product of the different rates of population growth associated with each fertility specification. We will come back later to this point.

In any event, the common features reproduced by the competing specifications suggest the robustness of the model specification in that is capable of generating a common structural profile of development relatively independent of the rate of population growth. That is, it suggests that an important explanation of the results might be due to the dualistic socioeconomic structure captured by the model.

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[149] See Table 1.6.

[150] Indeed, urban real wage rates were raised substantially above equilibrium concomitant to independence in Africa, in the late sixties. From then onwards, several countries have attempted to reduce urban real wages and/or the very functioning of these economies facing mounting population pressure have conveyed to this result. See Montgomery (1985).

Certainly, the fact that the different specifications reproduce common features of development is due to the relatively short span of time analyzed by the model (30 years) in order to manifest the full socioeconomic impact of changing rates of population growth.

Robustness of Each Fertility Specification

Even though the three specifications reproduce general features of the pattern of development, some of them produce subtle departures from this pattern. These departures may not be dramatic because of the same reasons given above. That is, the span of time analyzed is too short to manifest their full impact.

A first indication of departure is given by the different rates of growth of income per capita generated by each specification. The rate of growth of per capita income ranges from 1.6% in BCASE1 to 2.2% in BCASE3. This rate is 1.9% in BCASE2. Even though, it is difficult to establish a representative rate of growth of income per head for the region, this can be situated in the range of 1.8 and 1.2 per cent per annum, approximately. [5] Thus, it seems that the rate of income growth starts departing from the expected range as the elasticity of fertility with respect to income per head rises.

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[5] See table 1.2 and World Development Report (1984). It is not possible to be more precise about this rate, because of the existence of two types of economic performances among these countries, and also because the inclusion of slightly

The fact that the rate of growth of income per head rises as the income elasticity[152] of fertility rises, is a result of the lower rate of population growth in the more income-elastic specifications. This lower rate of population growth, in turn, is a result of a much greater decline of fertility than mortality in these specifications. For instance, in BCASE1, the national crude birth declines from 51 to 47 while the crude death rate declines from 17 to 13 approximately during 1970-2000. In BCASE3, the crude birth rate declines from 51 to 34 while the crude death rate declines from 17 to 12 approximately during the same period.

Specifically, the rate of population growth in BCASE1 is 3.4 percent while in BCASE3 is 2.4 percent and in BCASE2 is 3 percent. Obviously, the rate of population growth of BCASE3 departs from an expected range of 3-4 percent for the region.[153]

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[151](cont'd) different periods alter significantly the results. For instance, the group of successful countries: Kenya, the Ivory Coast, Nigeria and Zimbabwe, more akin to the model, displays a rate of growth of per capita income of 2.4 percent in the period 1960-1980. This falls to 1.2 percent when the different period 1965-1987 is considered. The average between the two periods is approximately 1.8.

[152]This is an abbreviation for the income per capita elasticity.

[153]The actual average rate of natural increase of our eight selected African countries around 1990 was 3.4 percent approximately (see table 1.1). For the year 1990, the model with the fertility specification BCASE1 generates a rate of natural increase of 3.3 percent; BCASE2 generates a corresponding rate of 2.9 percent and BCASE3 one of 2.3 percent.

The above apparent departures of BCASE3 from the stylized facts, however, can be interpreted either as a result of an unrealistic mortality specification (common to the three runs) or as a result of an unrealistic fertility specification.

That is, in specification BCASE3, mortality would not decline even though economic conditions change; while fertility would decline more rapidly as income per capita rises. This would produce the artificially low rate of growth of population. Furthermore, the interaction of the incorrect mortality specification with the correct more income-elastic fertility specification would lead to cummulative errors. In particular, the extremely low rate of population growth would reinforce positively the rate of growth of income per capita. The latter, in turn, would exaggerate the fertility decline.

Let us attempt an examination of this more complex situation. First, the differences in mortality decline among the three runs are not nil. In fact, the crude death rate falls by approximately an additional point (0.8) in BCASE3, relative to BCASE1. That is, in BCASE1 the national crude death rate falls from 17.3 in 1970 to 12.8 in 2000, while in BCASE3 it falls to 12.04 in 2000.[154] The small differential in the fall of mortality is explained by the fact that the average real wage in BCASE3 is only 6 percent higher than the average real wage rate in BCASE1, in the year 2000.

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[154] The crude birth and death rates are per thousand rates.

Income per capita in BCASE3 is 19 percent higher than the income per capita in BCASE1 for the same year.

Mortality as specified, is affected directly by the real wage rate and indirectly by income per capita. In other words, the modeled effect of income per capita on mortality acts indirectly through the wage rate, food consumption and internal migration. Now, from a point of view of the real-wage elasticity of mortality, the change in mortality seems realistic. Indeed, it would be difficult to justify a further reduction in mortality because of a rise in the above magnitude of income per capita, which does not translate into a similar increase in the real wage rate.

Second, let us assume that the inconsistent match of the rate of natural increase of BCASE3 with the actual rate of natural increase for the region, is product of a misspecification of mortality. Let us also assume that the fertility specification BCASE3 is correct. In this case we can try to answer different kind of consistency questions.

First, given a realistic rate of growth of income per head e.g. the one of BCASE1 (1.6 percent per annum), what would be the resultant crude birth rate of specification BCASE3. We have calculated approximately these rates for 1980, 1990 and 2000 as 44, 39.6 and 37.6, respectively.[155] These fertility levels are well below the levels suggested by the available evidence on fertility trends in the stylized economy (table 5.2). Most importantly, the crude birth rates generated by the specifications BCASE1 and BCASE2 match noticeably better the available evidence.

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[155] The parameters of the specification BCASE3 and BCASE2 are presented in table 5.4, at the end of the chapter.

Second, we can ask what rate of growth of income per capita would be necessary in order to produce a national crude birth rate around 50 in 1980, using the specification BCASE3 (the latter crude birth rate would be compatible with Kenyan evidence). The required rate of growth of income per capita would have to be approximately 0.5 percent per annum. However, to reproduce such a small rate via the effect of a faster mortality decline in the context of this model may be impossible and unrealistic. Thus, it seems that the model would need to generate crude death rates too low, perhaps close to zero or even negative, in order to generate rates of population growth high enough to achieve the above small rate of growth of per capita income (0.5 percent).[156] In other words, there would not be apparently a realistic pattern of mortality decline compatible with the fertility specification BCASE3 for the stylized country modeled.

Now let us assume that our mortality specification is correct and examine the fertility decline depicted by the specification BCASE3 in relation to the other specifications. This comparison is done by using the available evidence of fertility trends in Kenya (table 5.2). It seems clear by simple visual inspection that the fertility specification BCASE3 produces an extreme departure from the actual pattern of demographic change.[157] Instead, BCASE1 produces the overall closest fit to the World Bank series of data. BCASE2 produces also a reasonable fit.

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[156] The exercise was not attempted. Thus, the above claim is only a reasonable speculation.

The specification BCASE3 generates a too rapid decline in fertility producing an increasing gap with the evidence. For instance, it generates crude birth rates of 42.5, 41 and 37.8 for the periods 1980, 1985 and 1990, respectively (table 5.1). The World Bank evidence points to crude birth rate levels of 51, 54 and 45 for these years, respectively. The specification BCASE1, instead, generates more realistic crude births rates of 50.7, 50.4 and 49 for the years 1980, 1985 and 1990, respectively. In turn, the specification BCASE2 also generates generates more realistic crude birth rates of 50.2, 49.5 and 44 for these years.

Most importantly, the information of table 5.2 suggests basically a situation in which the actual level of fertility remained in a high plateau until the early eighties, to start declining mildly thereafter. This pattern is reproduced fairly accurately by the specifications BCASE1 and BCASE2 (see table 5.2). The fertility specification BCASE3 does not and cannot reproduce this behaviour. Indeed, only specifications which assume an interactive relation between fertility and development are equipped to reproduce this type of fertility change.

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[157] There are several other possible speculations in order to highlight the inconsistency of specification BCASE3. For instance, one could assume hypotetically that the resultant crude birth rate in 1990 is correct but the crude death rate is incorrect. In a simple analysis, without considering feed backs of the rate of population growth on the rate of growth of income per head, one could ask what would be the crude death rate necessary to produce a rate of natural increase consistent with the stylized facts. Given a low boundary for the rate of natural increase of 3 percent and the 1990 crude birth rate of 37.8, it would have been required a maximum crude death rate of 7.8 to produce a consistent rate of natural increase with the specification BCASE3. This mortality level for the region, however, is 2.2 points lesser than the actual minimum crude death rate observed in the examined countries in 1990 (10 in Kenya). The average crude death rate was in the range of 13-14. Hence, it is possible to suggest that the crude birth rate obtained in BCASE3, seems too low and inconsistent with the Sub-Saharan pattern.

In fact, the good fit of BCASE1 and BCASE2 may be precisely explained because of their assumed inverted u-shaped relations between rural fertility and development. In addition, this is perhaps the only way of reconciling the above information of Kenyan aggregate fertility levels with additional demographic information quoting almost uninterrupted declines in urban fertility in Kenya (DHS, 1991: 2021; World Bank, 1980: 20).[158]

It must be said, that there is not total agreement on the interpretation of the Kenyan fertility trends displayed in table 5.2. Specifically, there is consensus in that Kenya's fertility level did rise during the seventies, at least. Even though, the extent of the rise has been exaggerated by inaccurate data. Thereafter, the consensus points to the fact that the decline in fertility has been extremely low until 1987 (Page, 1988). Finally, there is no agreement whether the "significant" decline in fertility estimated in 1988 is or not realistic (Page, 1988).[159] This is, the reason why most models and/or empirical studies of the region obtain an extremely low elasticity of fertility with respect to income per capita (Faruqee and Gulhati, 1983; Anker and Knowles, 1984).

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[158] Unfortunately, there are not available disaggregated time series estimates for rural and urban crude birth rates.

Once it is more or less clear that the inconsistent pattern of population gowth of BCASE3 may be mostly a product of the fertility specification, it is possible to analyze other indications of departure by the specification BCASE3. Certainly, all of them are related to the apparently inconsistent low fertility and subsequent low rate of population growth generated by this specification.

For instance, the rate of growth of the rural population is also too low, 1.4 percent, contrary to the evidence suggesting a rate in the order of 2-2.4 percent (table 1.5). The corresponding rates of BCASEs 1 and 2, are 2.5 percent and 2 percent, respectively. The rate of urban growth also declines toward its lower expected boundary as the income elasticity of fertility declines. In addition, the level of urbanization tends to be slightly inflated by the abnormally low rate of natural increase of BCASE3. For instance, World Bank (1992) data of urbanization for Kenya give an estimate of 24 percent urban for 1990. BCASE1, gives an urban percent of 28.2 percent, BCASE2 gives one of 28.7% and BCASE3 one of 30 percent (table 5.1). The difference is enhanced over time. That is, the specification BCASE3 generates an urban percent of the population approximately of 38 percent for the year 2000, while the specification BCASE1 generates an urban percent of the population of 34 percent.

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[159] The decline in fertility in 1988 has been reported only by the 1989 Kenyan Demographic and Health Survey. Indeed, the Kenyan Contraceptive Prevalence Survey of 1984 reported a TFR of 7.7 in comparison to the TFR of 6.7 reported by the KDHS in 1988-89. See Demographic and Health Surveys World Conference (1991, 2029).

The indicators of structural change in production provide also subtle indications of a departure of BCASE3 from the main developmental pattern. World Bank (1992) data, situate the shares of agriculture, manufactures and aggregate services in Kenyan GDP in 1990, as 28 percent, 21 percent and 51 percent, respectively (See table 5.1). BCASE1 estimate these shares as 26.5, 22 and 51.5 percent. BCASE2 estimate them as 26, 23 and 51 percent, and BCASE3 estimate them in 25.5, 23.5 and 51 percent. The figures of the BCASEs are averages that conceal somewhat the real changes in GDP shares.[160]

In sum, many of the differences observed among the three specifications except for those most directly related to the rate of population growth may seem little in order to consider BCASE3 inconsistent with the developmental pattern. It is worth repeating that this is due to the fact that changes in the rate of population growth take time to produce more dramatic economic changes. In conclusion, the data of table 5.1 and table 5.2 , overall, suggest a ranking of a better fit of BCASE1, followed by BCASE2 and finally BCASE3 to the pattern of development and demographic change of the region.

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[160] The model tends to produce short term oscillations in these shares, although, with a clear long term trend. This masks somewhat the real changes in the shares when the differences in the rate of growth of the economy are not pronounced.

On the other hand, it is convenient to caution the reader that there may be sufficient variations in the specifications of both fertility and mortality which could produce better replications of the stilized facts. In other words, our preceding discussion points to the fact that the specifications BCASE1 and BCASE2 are reasonable, not the best specifications.

Discrimination between BCASE2 and BCASE3

It must be noticed that the time paths of fertility generated by BCASE1 and BCASE2, start diverging after 1987. Specifically, the specification BCASE1 generates crude birth rates of 49 and 47.3 for the years 1990 and 2000 while the specification BCASE2 generates crude birth rates of 44 and 41 for these years.

In essence, the theoretical model of fertility underlying specification BCASE1 continues generating the Sub-Saharan African pattern of fertility decline " resilient to modernization" described by the demographic literature (Faruqee and Gulhati, 1983; Frank and Mcnicoll, 1987). The fertility behaviour generated by specification BCASE2 starts conforming to the change in the Kenyan pattern of fertility decline, suggested by the actual unexpected decline in

Kenyan fertility occurred in 1988. There are several speculative explanations for the divergence between the specifications Bcase1 and Bcase2 after 1987, which will not be discussed here. For instance, the Kenyan fertility decline of 1988 may be only an artifact. (61) Instead of discussing these possibilities, we prefer to conclude that we are left with two realistic specifications of fertility. The specification corresponding to BCASE1, is more theoretically comprehensive, and thus, it would be used to explain the functioning of the model and most of its policy analysis. The specification corresponding to BCASE2 is mostly a predictive device which can be used to replicate those policy experiments more sensitive to fertility specification.

The Mortality Specification

The mortality specification of the model was calibrated to reproduce the average behaviour of the AFS rather than the lower mortality of Kenya. This is why our mortality is always greater than the one of Kenya, indeed, one of the lowest of Africa (see table 5.1). (62)

This produces most of the differences in the economic structure between BCASE1 and BCASE2. A different specification was attempted oriented to produce mortality decline more congenial with the one of Kenya. This constitutes BCASE2a presented in table 5.3. In this specification, the mortality curve is shifted down one point, in order to start at closer levels of 1970 Kenyan mortality (crude birth rate of 16 instead of our starting crude death rate close to 18).

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(61)The recent findings of the Kenyan Demographic and Health survey (DHS) of a first time important fertility decline for the year 1989 (TFR estimated in 6.7) is what has given support to World Bank estimates for the crude birth rate as 45 in 1990, instead of levels close to 50 (Demographic and Health Surveys World Conference, 1991; volume 3: 2020), as it was estimated until recently.

(62)The reader must be cautioned that this fact does not change the essence of the previous analysis.

In addition, the rate of technological change affecting mortality was endogenized as a positive nonlinear function of income per head. The rate of technological change increases first at an increasing rate, then at a decreasing rate until reaching an asymptotic level close to 2 percent, as income per head rises. It was felt that this "experimental" ad-hoc modification could capture some theoretical effects of income per capita on mortality which the previous specification was missing.[163]

The results in table 5.3, show the change in BCASE2 when this specification is added (BCASE2a). In sum, the development pattern generated is very similar to the one of Base1 but with lower mortality levels. This specification of mortality will be used eventually in some of the policy experiments just for the purpose of approaching closer to Kenyan reality.

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[163] In particular, the fact that the government health policy was assumed to be relatively independent of the rate of growth of income.

TABLE 5.1

BASIC CASE SENSITIVITY TO FERTILITY SPECIFICATION
(Critical Observations of Time Path Included)

VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY				BASIC CASE3 FERT: (-) FUNCTION INCOME PER HEAD HIGH ELASTICITY			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
GDP or National Income(a)	5%	455		2086	4.9%	455		1957	4.6%	455		1797
Population	3.4%	5181		14340	3%	5181		13115	2.4%	5181		10945
Income per head(c)	1.6%	100		161	1.9%	100		177	2.2%	100		192
Food per head production (index)		100		76		100		91		100		93
Urban Population	6.8%	637		4856	6.7%	637		4742	6.2%	637		4172
Urban %		12%	28.2%	34%		12%	28.7%	36%		12%	30%	37.7%
W.Bank Data Kenya Urban %			24%				24%				24%	
Rural Population	2.5%	4544		9483	2%	4544		8372	1.4%	4544		6886
Rural %		88%		66%		88%		64%		88%		62.3%
External Balance Variables												
Deficit as % of GDP(d)		8.7%		15.5%		8.7%		14.5%		8.7%		12%
Average Deficit	8.4%				b				b			
Foreign Debt as % of GDP(d)	4%	35%		120%	2.7%	35%		108%	b	35%		95%

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VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY				BASIC CASE3 FERT: (-) FUNCTION INCOME PER HEAD HIGH ELASTICITY			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
	Production: Sectoral Shares in GDP											
Agriculture	2.6%	39%	26.5%	18.9%	2.7%	39%	26%	18.5%	2.2%	39%	25.5%	18.8%
Kenya Ag.Share World Bank			28%				28%				28%	
Manufactures	7.0%	14.7%	22%	28%	7.2%	14.7%	23%	29%	7%	14.7%	23.5%	30%
Kenya Manuf. Share World Bank			21%				21%				21%	
Services	5.5%	36%		42%	5.4%	36%		42%	5%	36%		40%
Housing	5.3%	6.4%		7%	5.4%	6.4%		7%	5.1%	6.4%		7.5%
Construction	4.3%	3.5%		2.9%	4.2%	3.5%		2.9%	4%	3.5%		3%
Aggreg. Services		46.3%	51.5%	52.6%		46.3%	51%	52.3%		46.3%	51%	51.6
Kenya Aggreg.Serv. Share W.Bank			51%				51%				51%	
	Employment: Sectoral Shares in Total Employment											
Agriculture	2.5%	88%		67.2%	2%	88%		64%	1.2%	88%		62.3%
Manufactures	7.5%	2%		6.9%	7.5%	2%		7.7%	6.8%	2%		7.5%
Services	6.5%	10%		25%	6.3%	10%		26.6%	5.8%	10%		28%

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VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY				BASIC CASE3 FERT: (-) FUNCTION INCOME PER HEAD HIGH ELASTICITY			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
Changes in Real Wages and Prices (e)												
	% Change											
Urban Average Wage . . .	-34%	220		149	-32%	220		150.5	-30%	220		153
Urban Modern Wage . . .	-26%	152		112	-27%	152		110	-23%	152		117
Urban Informal Wage . .	-36%	109		70	-33%	109		72.9	-36%	109		69
Rural Wage	-23%	31		24	-20%	31		24.8	-10%	31		28
National Average	+23%	53.7		66.5	+30%	53.7		70	+40%	53.7		70.4
Price Index		1		8.9		1		8.96		1		8.75
Human Capital Variables (real expenditure and consumption per head: quantities)												
	% Change											
Urban Food Consumption .	-28%	43.6		31.2	-28%	43.6		31	-28%	43.6		31.8
Rural Food Consumption .	-11%	18.3		16.2	-11%	18.3		16.7	-1.5%	18.3		18
National Food Consp. . .	5%	21.3		24.6	2%	21.3		21.8	9%	21.3		23.2
Urban Health Expend. . .	+20%	7.3		8.8	+20%	7.3		8.7	+20%	7.3		8.7
Rural Health Expend. . .	+63%	3.6		5.9	+63%	3.6		5.9	+63%	3.6		5.9
Urban Skilled %		45.7%		60%		45.7%		58%		45.7		59%
Rural Skilled %		27%		23%		27%		22.5%		27%		21%

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VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY				BASIC CASE3 FERT: (-) FUNCTION INCOME PER HEAD HIGH ELASTICITY			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
Demographic Variables												
Urban Birth Rate		40		33		39		33		39		32.8
Urban Death Rate		10.4		10		10.5		9.3		10.4		9.4
Urban Life Expectancy .		61.8		62.6		61.8		63.9		61.8		63.8
Urban Natur. Increase .		2.95%		2.3%		2.8%		2.3%		2.8%		2.3%
Aver. Urban Nat.Incr. .	2.7%				2.3%				2.3%			
Inmigration Rate(f) . .	4.1%				4.4%				3.9%			
Inmigration Contribution to Urban Increase (%) .	60%				66%				63%			
C-D Development Index Rural		123		108		b	b	b		b	b	b
Rural Birth Rate		52.9		54.7		52.4		45.3		52		34.9
Rural Death Rate		18.3		14.3		18.4		13.9		18.7		13.7
Rural Life Expectancy .		47.5		54.7		47.2		55.5		46.6		55.8
Rural Natur. Increase .		3.46%		4.04%		3.4%		3.1%		3.3%		2.2%
Aver. Rural Nat.Incr. .	3.4%				3.2%				2.6%			
Outmigration Rate(g) . .	0.9%				1.2%				1.2%			
National Birth Rate . .		51	49	47.3		51	44	41		51	37.8	34
Kenyan Birth Rate World Bank		50-52	45			50-22	45			50-52	45	
National Death Rate . .		17.3	15.4	12.8		17.3	15.3	12.2		17.5	15	12.04
Kenyan Death Rate World Bank		17	10			17	10			17	10	
National Life Expec. .		49		56.7		49		58.6		48.9		58.8
National Natur. Incr. .		3.48%		3.45%		3.3%		2.9%		3.3%		2.1%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms. d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. In(out)migration rate defined as annual rate of urban (rural) growth minus the average rate of urban (rural) natural increase.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some variables are actually average values for the two years 1999-2000. (GDP, income per head, deficit, sectoral shares of production and employment, wages and price index).

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TABLE 5.2

ADJUSTMENT OF KENYAN FERTILITY TRENDS TO THREE MODEL SPECIFICATIONS OF FERTILITY

YEAR	KENYAN FERTILITY TRENDS (WORLD BANK)		MODEL FERTILITY SPECIFICATIONS		
	CRUDE BIRTH RATE	TOTAL FERTILITY RATE	BCASE1-CRUDE BIRTH RATE	BCASE2-CRUDE BIRTH RATE	BCASE3-CRUDE BIRTH RATE
1970	51.0a	7.8	50.7	50.7	50.3
1975	50.5	7.6?	50.7	49.8	44.5
1980	51.0	7.8	50.7	50.2	42.5
1981	55.0	8.0	51.9	50.1	42.5
1982	55.0	8.0	50.7	49.9	43.5
1983	55.0	8.0	50.5	49.5	41.3
1984	53.0	7.9	50.8	49.6	41.7
1985	54.0	7.8	50.4	49.5	41.0
1986	52.0	7.7	48.6	45.3	39.6
1987	52.0	7.7	49.5	49.4	39.9
1990	45.0	6.7	49.0	44.0	37.8
2000	41.0b	5.5b	47.3	41.0	34.0

Sources: World Development reports 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1998, 1989, 1992 (World Bank) and United Nations Demographic Yearbooks, 1980, 1979.

a. Different figures are given for the crude birth rate in 1970. The range is 50-52.

b. Approximate World Bank Estimates. (?) Interrogation sign: means that the estimate is not clear.

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TABLE 5.3

BASIC CASE SENSITIVITY TO FERTILITY AND MORTALITY SPECIFICATION
(Only Critical Observations Included)

VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY SAME MORTALITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY SAME MORTALITY				BASIC CASE2A FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY HIGHER INCOME ELAST. OF MORTAL.			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
GDP or National Income(a)	5%	455		2086	4.9%	455		1957	4.98%	455		2027
Population	3.4%	5181		14340	3%	5181		13115	3.34%	5181		14128
Income per head(c) . .	1.6%	100		161	1.9%	100		177	1.6%	100		161
Urban Population . . .	6.8%	637		4856	6.7%	637		4742	6.8%	637		4980
Urban %		12%	28.2%	34%		12%	28.7%	36%		12%	27%	35%
Kenya Urban %			24%				24%				24%	
Rural Population . . .	2.5%	4544		9483	2%	4544		8372	1.4%	4544		9148
Rural %		88%		66%		88%		64%		88%		65%
Production: Sectoral Shares in GDP												
Agriculture	2.6%	39%	26.5%	18.9%	2.7%	39%	26%	18.5%	2.5%	39%	26.9%	18.5%
Kenya Ag.Share			28%				28%				28%	
Manufactures	7.0%	14.7%	22%	28%	7.2%	14.7%	23%	29%	7.2%	14.7%	21%	28.9%
Kenya Manuf. Share . .			21%				21%				21%	
Services	5.5%	36%		42%	5.4%	36%		42%	5.5%	36%		42.3%
Aggreg. Services . . .		46.3%	51.5%	52.6%		46.3%	51%	52.3%		46.3%	52.1%	52.6%
Kenya Aggreg.Serv. . .			51%				51%				51%	

VARIABLE	BASIC CASE1 FERT: (+) AND (-) FUNCTION OF DEVELOPMENT INDEX MEDIUM ELASTICITY SAME MORTALITY				BASIC CASE2 FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY SAME MORTALITY				BASIC CASE2A FERT: (+) AND (-) FUNCTION OF INCOME PER HEAD MEDIUM ELASTICITY HIGHER INCOME ELAST. OF MORTAL.			
	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000	Growth rate (annual)	1970	1990	2000
Demographic Variables												
Urban Birth Rate . . .		40		33		39		33		39		33
Urban Death Rate . . .		10.4		10		10.5		9.3		9.5		7.2
Urban Life Expectancy		61.8		62.6		61.8		61.7		61.8		65.9
Urban Natur. Increase		2.95%		2.3%		2.8%		2.3%		2.9%		2.6%
Rural Birth Rate . . .		52.9		54.7		52.4		45.3		52		45.7
Rural Death Rate . . .		18.3		14.3		18.4		13.9		16.9		11.5
Rural Life Expectancy		47.5		54.7		47.2		55.5		46.6		58.14
Rural Natur. Increase		3.46%		4.04%		3.4%		3.1%		3.5%		2.2%
National Birth Rate .		51	49	47.3		51	44	41		51	44.4	41.2
Kenyan Birth Rate . .		50-52	45			50-22	45			50-52	45	
National Death Rate .		17.3	15.4	12.8		17.3	15.3	12.2		16	12.7	9.98
Kenyan Death Rate . .		17	10			17	10			17	10	
National Life Expec.		49	54.4	56.7		49	52.9	58.6		49.7	57.5	60.8
Kenyan Life Expectancy		49	59			49	59			49	59	
National Natur. Incr.		3.48%		3.45%		3.3%		2.9%		3.46%		2.1%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms. d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. In(out)migration rate defined as annual rate of urban (rural) growth minus the average rate of urban (rural) natural increase.

Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.

Note 2: The displayed values for the year 1990 and 2000 of some variables are actually average values for the two years 1999-2000. (GDP, income per head, deficit, sectoral shares of production and employment, wages and price index).

Note 3: Kenyan data from World Development Reports 1984, 1989, 1992 (World Bank)

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5.2 Detailed Analysis of the Time Path 1970-2000 and Functioning of the Model

In this section, we discuss at a more detailed level the basic run corresponding to the BCASE1 specification. It must be clear by now that the generated results are rooted in seemingly robust assumptions. The demonstration of this point was precisely attempted in the first section.

Main Results

The main results of the simulation are displayed in the three first columns of table 5.1.[164] In essence, the time path can be characterized by a low and declining rate of economic growth and increasing external indebtedness. Specifically, our hypothetical country displays a rate of GDP growth of 5 percent annually and a rate of population growth of 3.4 percent annually. Income per head, thus, grows by 1.6 percent annually, increasing 1.6 times during the 1970-2000 period. The model reproduces economic cycles, thus, the pattern of economic growth is not uniform. The external debt, in turn, grows from an initial 35 percent of GDP to a level of 120 percent of GDP[165]

Agriculture production grows at a 2.6 percent annual rate, below the rate of population growth of 3.4 percent. The index of agriculture production per head with base 100 in 1970 falls to 76 by the year 2000. Agriculture production also grows at a lower rate than agricultural domestic consumption, which grows at a similar rate to population (3.8 percent). Thus, the initial agricultural exportable surplus is totally exhausted and the country becomes a net importer of agricultural products by the year 2000.

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[164] The detailed results for all variables and experimental runs of the model, are of public dominion at the Population Research Laboratory of the University of Alberta.

[165] This is GDP at market prices.

The urban economy grows strongly during 1970-2000. Indeed, manufactures production grows at 7 percent annually while services and housing grow at rates of 5.5 and 5.3 percent, respectively. Although, the growth of the manufacturing sector is strong and the country starts exporting manufactures, the growth is not sufficient to compensate for the decline in agricultural exports. In this sense, the transition from agriculture to industry is premature and/or cannot avoid the path of this economy to the verge of an external debt crisis and consequent economic stagnation.

Systematic government expenditure beyond government revenues is another, albeit, minor source of increasing external indebtedness. The government debt constitutes approximately a fifth of the total foreign debt in the year 2000. The increase in social expenditure, though, permits educational real expenditure to increase six times and real health expenditure five times from 1970 to 2000. Specifically, health real per head expenditure increases by approximately 70 percent while that of education increases by 84 percent.

Urbanization accompanies, of course, the growth of industry and services. The urban share of the population grows from 12 percent in 1970 to 34 percent in the year 2000. That is, urban areas grow at a 6.8 percent annual rate during the period. The rural-urban transformation of the economy is summarized by the changing shares of each productive sector in GDP. The share of Agriculture in GDP declines from 39 in 1970 to 19 percent in the year 2000. The share of manufactures increases from 15 to 28 percent and the one of services plus housing and construction, increases from 46 to 52.5 percent, during the period.

At this initial stage of urbanization, rural-urban migration contributes strongly to urban growth. In fact, rural-urban migration contributes on average 60 percent of the growth in the cities while urban natural increase contributes 40 percent. The magnitude of rural to urban migration implies that approximately 30 percent of the new cohorts of workers in the rural areas emigrate to the cities.[166] Internal migration, is actually an unstable and irregular process. That is, strong inmigration waves may be followed by periods in which rural to urban migration becomes negligible, and even urban-rural migration obtains. This instability reproduces particular features of African internal migration (Day et al., 1987).[167]

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[166] These rates of inmigration and urban growth can be considered high or low depending on different perspectives. For instance, the African countries facing these rates of growth of cities have considered them a major social and economic issue (Todaro, 1978; Todaro and Stilkind, 1981). On the other hand, given the extreme rural urban income inequality in these countries it is surprising that these rates are not higher.

[167] For instance, an important flow of immigrants in the first period, is followed by a declining flow of inmigration

Rural-urban migration drains human capital from the country side. In other words, skilled rural workers migrate to the cities in greater numbers than unskilled workers. The percent of skilled workers in rural areas declines from 27 in 1970 to 23 in the year 2000. The reverse takes place in urban areas. In this sense, the efforts of the government to upgrade rural education and reduce the urban-rural educational gap, are frustrated.

The national labour force experiences a threefold increase in the thirty years period.[168] The urban labour force, in turn, experiences an eightfold increase during the period. Employment expansion does accommodate this extraordinary increase in the labour force, though, at expense of a deterioration in the real wage rate in both rural and urban areas.

Specifically, sectoral labour absorption proceeds as follows. Agriculture employment grew at a rate of 2.5 percent annually, absorbing 54 percent of the increase of workers. Services and manufactures employment grew at rates of 7.5 and 6.5 percent, respectively, absorbing the remaining 46 percent. The informal sector performs an important role in urban labour absorption acting as a "sponge", as described by ILO (ILO, 1972; Livingston, 1986).

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[167] (cont'd) until period 8. The inmigration flow at period eight has become 17 times lower than the one in the first period. A second small cycle starts then, until reversal migration obtains in period 12. A third cycle can be identified between period 12 and period 18, and so on.

[168] The labour force increases from 5,181,000 to 14,340,000 during 1970 to 2000.

Indeed, when the sector is not regulated by the government, it can employ even 50 to 60 percent of the urban labour force.[169] Labour grows at a faster rate than production in the sectors of manufactures and the aggregate of informal and formal services. Thus, average labour productivity is falling in both sectors, though the fall is faster in services, reflecting the greater labour absorption capacity of services.[170]

The urban average real wage[171] falls by 34 percent and the rural real wage falls by 23 percent during the period. Despite the fall in these real wage rates, the real income of the average worker (urban worker and peasant) of the whole country, rises by 19 percent between 1970 and 2000. This apparently paradoxical outcome in view of the above results, is due to rural-urban migration, and shifts in the spatial distribution of the population. That is, rural to urban migration shifts labour from rural to urban areas where the real wage derived by labour is greater.[172] The fact that internal migration improves income distribution is an outcome of most economic-demographic models emphasizing dualistic conditions (Adelman and Robinson, 1978; Mohan, 1984; Anker and Knowles, 1983). What is novel in this model, is that the result obtains even though both urban and rural real wages deteriorate.

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[169] The informal sector employed 62 per cent of the urban labour force in period 12, 55 percent in period 18, and 48 percent in period 21. This displays a typical trend of relative surplus labour economies to exhibit important shares of urban employment in informal services (Mazumdar, 1976, 1977).

[170] The ratio of aggregate services-employment to manufactures-employment in fact declines from 5 to 3.6 corroborating the Preston (1979), United Nations (1980), Gregory (1980) and Udall (1976) assertion in the sense that there is not absolute overurbanization. However, we are skeptical about the very meaning of the latter concept, and thus, on the meaning of this test.

[171] This is the average between the modern and the informal sector real wages.

[172] The real income gain of inmigration diminishes on time but, in general, continues existing. Thus, provided this income gain persists and that neither the urban nor the

The income distribution of the country worsen for labour and changes in favour of capital. That is, income per capita has increased by 60 percent during 1970 to 2000, however, the income of workers has increased only by 20 percent. Hence, the difference corresponds to a greater increase in capitalists' share of national income. This result corroborates the known stylized fact that the income distribution deteriorates at the initial stages of development. The novelty, is to show that rapid population growth might worsen an otherwise mild expected deterioration in it (Bloom and Freeman, 1987). [173]

The Demographic Results

The urban crude death rate declines slightly from 10.4 to 10 per thousand, and the urban crude birth rate declines from 40 to 33 per thousand over the 1970-2000 period. The rate of urban natural increase, thus, has fallen from approximately 3 percent to 2.3 percent per annum.

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[172] (cont'd) rural real wage deteriorate much, the result of higher urbanization achieved mostly by internal migration, is an increase in the real wage of the average worker of the country.

[173] The Swan et al (1987) model of Kenya, apparently generates similar results under some experimental conditions. Those results, however, were not available for this research.

In the rural areas, the crude birth rate has increased from 52.9 to 54.7 per thousand while the crude death rate has fallen from 18.3 to 14.3 per thousand. The rate of rural natural increase, thus, has increased from 3.5 in 1970 to 4 percent in the year 2000.

The national demographic results are a weighed result of urban and rural conditions. The national crude birth rate falls from 51.3 to 47.3 per thousand while the national crude death rate falls from 17.3 to 12.8 per thousand. The national rate of population growth, thus, remains essentially unchanged between 1970 and 2000 at a 3.5 percent each year.

These demographic outcomes must be understood as a function of the evolution of living conditions depicted by the model. That is, living conditions, insofar they depend upon real wages levels, e.g the amount of food consumption and housing quality, stagnate and in some instances deteriorate between 1970-2000. Living conditions deteriorate faster in urban areas, although, they continue to be significantly better than in rural areas.[174] On the other hand, the deterioration in living conditions in rural areas is almost negligible. The case of food consumption illustrates this point. In urban areas, food consumption per head falls from 43.6 food units to 31.2 food units between

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[174] This is so because of the extreme initial imbalance favoring urban areas.

1970 and 2000, while in rural areas, it falls from 18 to 16.[175]

Educational and health real expenditures which affect directly living conditions increase substantially due to government efforts between 1970 and 2000. Nevertheless, the educational level in urban and rural areas, measured by the percent of skilled workers in the corresponding urban and rural labour force, decreases in rural areas while increases in urban areas. This is so, because of greater rural to urban migration of skilled workers. Health policy is successful in upgrading both urban and rural health real expenditure per head, and at the same time diminishing the gap favoring urban areas. Specifically, rural health expenditure per head increased by 63 percent while the urban one increased only by 20 percent. Still, the final level of urban expenditure per head ($8.8) is greater than the rural one ($ 5.9 per head).

Therefore, the mortality decline in rural areas occurs basically because of the government policy of increasing health care. The fact that food consumption does not decline significantly means that it does not counteract the effect of an increased health care on reducing mortality. Because rural mortality is initially at a relatively high level (the crude death rate is 18 per thousand in 1970), it is plausible to assume that exogenous measures have a great impact in reducing it.[176]

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[175] Similar results to these were apparently obtained by the Swan et. al. (1987) model of Kenya. Unfortunately, these results were not available for this research.

In short, the rural crude death rate declines to 14.3 per thousand by the year 2000, which is still higher than the urban crude death rate in 1970. It obviously does not decline more because neither the real wage nor education have increased. Rural life expectancy increases from 47.5 to 54.7 years.

This model result which arises from realistic prospects for economic growth prospects and evolution of the income distribution in Africa, "suggests" that mortality will not decline as fast as it is frequently assumed e.g. in World Bank projections.[177] Certainly, this assessment is conditional on our mortality assumptions which put some weight on endogenous factors (real wages and food consumption) in the determination of African Mortality. Hence, the result also suggests that the rate of population growth in Africa will not easily rise above 4 percent. This model result seems to agree with most recent demographic literature on Africa stating that the consequences of the "economic crisis" will reduce the speed at which mortality was declining in the region (Ewbank, 1988).[178]

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[176] The fundamental role of exogenous health measures in reducing African mortality is a proposition substantiated by most epidemiological and developmental literature. See Pradervand (1989), Gaisie (1979), Caldwell and Orubulaye (1975) and United Nations (1984). For Kenya, see Anker and Knowles (1983). The model is just making sense of the apparently paradoxical situation in which mortality can improve despite a stagnant economic situation, as it has occurred in several countries of Africa.

[177] Such projections assume crude death rates even below 10 per thousand, by the year 2000, in Africa (Faruqee and Gulhati, 1983).

The initial mortality level in urban areas is fairly low for the stage of development: the urban crude death rate is 10.4 per thousand. Hence, a reduction in mortality at such a low level is usually assumed to depend on poverty reduction. [179] Education may have also an important effect on reducing mortality.

However, the reduction in real wages and food consumption is of such magnitude so as to minimize the effects of government expanded health expenditure and higher educational level on mortality. In fact, the urban crude death rate declines only from 10.5 to 10 per thousand, and urban life expectancy at birth increases from 61.8 to 62.6 years.

It is worth noting that the time path of urban mortality is irregular. That is, the level deteriorates and improves following corresponding variations in urban living conditions, which derive from sharp variations in the real wage rate.[180] The model with respect to this point, captures combined effects of massive waves of rural-urban migration and slums formation.

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[178] Moreover, this concern has been especially addressed by the World Bank. See World Development Report, 1989 and Robert McNamara (1985).

[179] This is another common assumption in mortality which the model incorporates (Ewbank, 1988). Its realism should be judged by the reproduction of stylized mortality facts.

[180] For instance, from period 17 to 18, urban mortality, measured by CDRU, rises from 9.8 to 11.7 per thousand, before starting to decline again. Between these two periods food consumption per head declines by 100 percent.

Rural fertility cannot but increase in the above conditions. That is, only life expectancy has increased and that is because of exogenous measures: the health policy of the government. All other variables measuring the level of development, or quality of life, experienced by peasants have remained the same or even decreased, e.g. real wage, food consumption, educational levels. [181] In these circumstances, the peasants' motives to desire as many children as possible continues unchanged, and the fecundity constraint has been relaxed. Hence, the rural crude birth rate increases from 52.9 to 54.7 per thousand. The fact that food consumption has declined slightly, prevents the level of fertility from rising even more. However, it could not increase much further because is already close to natural fertility levels. [182]

In urban areas, the level of educational attainment has expanded significantly, and family size preferences have changed toward smaller families over time. Other variables denoting development or quality of life for urban residents --for example, the real wage rate-- have deteriorated. Life expectancy which affects fertility negatively has remained constant. In short, the former effects which reduce fertility dominate the latter effects which tend to maintain high fertility. Hence, the urban crude birth rate has declined from 40 per thousand in 1970 to 33 per thousand in the 2000 year.

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[181] The Cobb-Douglas combination of variables, or developmental index, COBFR (displayed in main table of results), which determines if fertility is positively or negatively affected by development, deteriorates. That is, COBFR falls from 123 to 108, even farther from the threshold level, 160, at which fertility would start declining.

[182] The proposition of better nourishment raising fertility is currently an empirical substantiated reality, especially in Kenya. See, World Bank (1980, 20). See also Anker and Knowles (1983) and the previous World Bank book, for extensive empirical support of the hypothesis. In addition, the point was sufficiently addressed in the sensitivity analysis.

As in mortality, the decline in urban fertility is not uniform. The urban crude birth rate (CBRU) tends to rise toward its original level when living conditions deteriorate. This situation is analogous to the one determining outbursts of mortality, explained above. In a sense, the model suggests the effects of rural migrants to urban areas initially induce higher levels of fertility, which take time to be extinguished. The relation, though, is not that immediate in the model. It is also worth noting that fluctuations in fertility will follow a course of dampening oscillations. For instance, a given fall in the real wage raises fertility more at the initial than at the final years of the simulation. This effect may be interpreted in different ways. The stronger explanation is sociological in nature, posing that attitudinal changes regarding family size, once they become firmly established, are unlikely to change, and hence become dominant in the determination of fertility.

Within the framework of assumptions of this model, these results make sense of pessimistic demographic views on Africa which state that there are no reasons to expect a significant decline in fertility by the year 2000 (Bongaarts et al., 1984; Frank and McNicoll, 1987). In particular, the model shows that it is not possible to expect declines in rural fertility if this present a positive causal relation with poverty and a negative causal relation with education and life expectancy after certain levels. In other words, the model shows that there is no reason for expecting the latter variables to improve substantially by the year 2000 in order to produce a decline in rural fertility.[183]

On the other hand, the model results also make sense of the World Bank literature arguing that an important decline in fertility might take place in urban areas (Faruqee and Gulhati, 1983). Certainly, this point is to some extent definitional, in the sense that the model assumes changing fertility tastes in urban areas. What the model does is to modify endogenously the speed of this decline through variations in the real wage rate, education affected by internal migration, and life expectancy affected by both education and the wage rate.[184]

Hence, a crucial determinant of the magnitude of population growth in Africa is the urbanization level. Though, as explained later, urbanization is an endogenous process which might also be inversely related to the rate of population growth.

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[183] True, if fertility responds to different variables than the above variables, the result would be different.

[184] The proposition of decreasing urban fertility is supported by the theoretical demographic literature and the empirical literature. See World Bank (1980: 20), Anker and Knowles (1982, 1983) and the chapter relevant to Sub-Saharan Africa (12) in "Fertility Behaviour in the Context of Development: Evidence from the World Fertility Survey. " (United Nations, 1988).

5.2.1 Why the Model Replicates The Developmental Time-Path

The situation of an initial relative surplus population in rural areas determines to a great extent the model results. Specifically, the small farms sector employs initially 84 percent of the national labour force while producing 29 percent of national income. In essence, this shows that there is too much population in the sector in relation to the share of GDP produced.[185] It also shows that agricultural labour productivity is low, especially in relation to urban areas.

The small farms sector produces initially the bulk of the agricultural product. Specifically, it produces 75 percent of it, and 50 percent of the agricultural exports. The big farms sector produces the remaining percent. Thus, the failure of the small farms sector in keeping a rate of production expansion close to the one of population growth, is determinant in the trend for an increasing external indebtedness. The infant manufacturing sector is not able to generate the expansion of exports necessary to check the decline in exports from the small farms sector, nor is the expansion in big farms exports able to do this.

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[185] In strict economic terms, this may be described as a long term missallocation of labour from the efficiency point of view, in which the marginal product of labour in urban areas is greater than in rural areas. Indeed, this is the essence of "dualism".

The rural population experiences initially a high rate of natural increase (3.4 percent), which corresponds to reality. This rate rises slightly through time in the model due to the effect of governmental health policies acting in a framework in which high fertility is deemed necessary by peasants.[186]

Given the assumed fertility behaviour (which better replicated reality), a decline in fertility given the educational and health policies would have required an extraordinary increase in peasants' income, which given the initial rural surplus character of the population is difficult to achieve. A decline in the rural rate of natural increase, induced by a rise in mortality, would have required either an unrealistically low rate of rural to urban migration or even some catastrophic event, e.g. civil war.[187]

The rural population growing at a rate of 3.4 percent per annum, would have reduced rapidly the labour productivity of peasants, as the ratio of composite land to labour[188] would have fallen. Most of the mechanisms which avoid this situation, e.g. accelerated technological change, inflows of capital into the sector, an increase in the price received by producers[189] are deemed unrealistic, given the structural features of this economy (discrimination against agriculture, dualism).

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[186] This is the description of the model functioning. Certainly, this fertility behaviour derives from our basic assumptions which, however, produce the pattern of economic change more consistent with the stylized facts.

[187] Thus, realistic variations in the rate of growth of peasants' income will simply determine the extent to which the rate of rural natural increase, rises from the initial 3.4 percent level.

[188] Composite land is defined as a Cobb-Douglas aggregate of land, capital, and technological change.

Therefore, rapid rural-urban migration, when the limits of land expansion are reached, constitutes the only available adjustment for peasants to avoid a decline in labour productivity and in per capita income. Internal migration slows down the actual growth of peasants' population in relation to the one of composite land. That is, it reduces the extent to which the land-labour ratio falls and, thus, it tends to maintain average product of the remaining workers constant or at least to slow down its decline.[190]

The rate of production growth of the sector declines significantly below that of population growth, because internal migration, even though rapid, is not enough to avoid a decline in labour productivity. In other words, at certain point, the labour force starts expanding at a greater rate than the composite land.

It is necessary to distinguish three phases in this outcome. In the first phase, during the initial eight years of the simulation, land expands at a rate equal to that of rural natural increase. In the same period, labour in the small farms sector grows, but at a significantly lower rate than the rate of natural increase, because of rural to urban migration. Thus, the land-labour ratio rises, which, in turn, increases labour productivity, income and capital stock per peasant. Even in this period, the rate of production of the sector increases only at a 2.7 percent. Internal migration occurs, in spite of rising rural income, because the urban side of the economy is growing faster, thus, "pulling" labour from the peasants' sector.

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[189] Kenya is perhaps the exception with respect to discrimination against agriculture in Africa (Ghai and Smith, 1987). However, this feature was ignored in the model in order to achieve generality in the representation of a typical industrial bias of developing countries.

[190] Certainly, given an extraordinary amount of internal migration the fall could be halted at all.

The paradoxical result is that income of the peasants who remain in the small farms sector, rises, even though the relative price of agriculture output has slightly declined. Big farms production in the period expands at a rate of 5 percent annually.

In the second phase, from period 8 to 13, the relative price of agricultural goods rises strongly to peak in periods 12 and 13 (coffee booms), and the rate of expansion of the urban economy slows down. In addition, the limit of land expansion for accommodating peasants is reached since period 8.

As a consequence of the change in the relative price of agricultural goods, internal migration is sharply reduced and the rate of labour growth in the small farms sector rises to 3.1 percent. The marginal product of labour in the small farms sector declines slightly, and the rate of growth of agricultural production declines only from 2.7 to 2.4 percent. In this phase, the capital accumulation of the first seven periods is more than offset by the rural labour force growth. The compensating effect of higher relative agricultural prices mitigates somewhat the effect of the greater labour absorption in the small farms sector. Big farms, in this period, continue to grow at a high rate because this sector's land base continues to expand, and because the declining agricultural wage rate increases their rate of profits.

In a third phase, from year 13 to the end of the simulation, the relative price of agriculture tends to decline. The urban economy is again stimulated. The rural rate of natural increase continues to rise. In these conditions, labour is both "pushed" and "pulled" out of agriculture. The rate of labour expansion in the peasants' sector falls to 2.4 percent. The rapid decline in labour productivity is unavoidable, and the rate of growth of production falls to 1.7 percent. The rate of growth of big farms production also falls to 3 percent, because land expansion in the sector has ended in period 18. The rate of production growth in big farms declines more rapidly than in small farms, because they use land intensive techniques while small farms use labour intensive techniques.

The Speed of Internal Migration

Peasants emigrate to the cities on the expectation of greater income there than that in agriculture. Given the initial disparities in rural-urban income, though, it would imply that internal migration could have been even faster than what the results indicate. There are several factors preventing this.

First, the cost of living in cities is greater than in rural areas. Thus, the rural-urban income imbalance exaggerates the economic advantages of cities. Furthermore, rural-urban migration produces a rise in the urban cost of living. That is, strong waves of rural to urban migration sharply rise housing rents, ultimately, because urban land expands slowly.[191] The economy adjusts to this situation but within a certain time-lag. That is, the initial effect of a strong inmigration wave is to raise the relative price of housing. This increases investment in the sector, and ultimately expands the housing supply, driving down its abnormal high price. The lags in the adjustment, though, are sufficient to slow down the flow of rural to urban migration.

Second, strong rural to urban waves of inmigrants from the country side, by expanding rapidly the supply of labour with respect to the stock of capital, reduce real urban wages. The effect is to reduce and in some years erase the rural-urban income differential. [192] Hence, it also reduces future rural to urban migration.

Lower urban real wages, though, reduce only temporarily the flow of internal migration. While reduced real urban wages slow down the growth of the supply of urban labour, they raise profits and investment, thus, raising the rate of growth of capital. In these circumstances, the marginal product of urban labour starts rising, and so does real urban wages. This tends to increase again rural to urban migration. On the other hand, without the relief of rural-urban migration, labour productivity in rural areas would decline, decreasing peasants' income. Thus, even though urban real wages remain low, rural to urban migration would resume driven by "push" forces.

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[191] The rate of expansion is exogenous, corresponding to a government policy.

[192] Sometimes, it can ever reverse the differential producing urban-rural migration.

The informal sector performs a role of urban reservoir of cheap labour for the modern sector, which delays the rise of modern sector wages. All of these phenomena, in addition to the fact that the migration decision is taken in view of past information, introduce sufficient lags for internal migration to be reduced.

Internal Migration, Income Distribution and Economic Growth

In a long term perspective, peasants' real wages can grow significantly only if the urban side of the economy grows more rapidly than the rural side. In addition, this rate of growth has to be strong enough to eliminate population pressure which maintains a low level of income in agriculture.[193] If this is not possible, demographic pressure on the land translates first into accelerated internal migration, which cannot but lead to a fall in urban real wages while keeping almost constant the lower rural wage. Second, the economic stagnation initiated in agriculture is transmitted to the urban economy leaving, without policy intervention, real wages to decline in both urban and rural areas.

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[193] That is, if rural real wages increase faster than urban ones, more population is retained in the country side, which leads ultimately to the decline of rural labour productivity and peasants' income. By the same reasoning, a situation in which peasants' real wages are declining faster than urban workers' ones, leads ultimately through increased rural-urban migration, to a rise in peasants' income.

The marginal product of labour is initially greater in urban than in rural areas, because the endowment of capital per worker and the technical efficiency level of urban production is greater than the composite land input per peasant and the technical efficiency level in rural areas. Therefore, a transfer of labour from rural to urban areas increases the rate of growth of the economy. The gain in productivity will remain until the marginal product in both rural and urban areas equalize. The latter outcome does not occur because of the existence of cost of living differentials. The gain in productivity is reduced as long as increased internal migration reduces the urban capital to labour ratio. Internal migration may decrease the urban wage rate, but at the same time it increases profit rates and raises capital formation. The incentives of greater capital formation in turn, by raising labour productivity, and hence labour demand, produces an even greater rural to urban migration flow.

Internal migration, by shifting consumption patterns in favour of urban goods, also stimulates the growth of the urban economy. This stimulus declines through time as the income of urban workers deteriorates. As urban wage rates decline, the consumption of urban goods decreases proportionately more than that of food. The only offsetting force in this regard is that capitalists' consumption of these goods might compensate for the decline by urban workers.

Relative Prices and External Factors

The external terms of trade in the model are determined by world market conditions. The effect of the relative price of agricultural goods on peasants' income is paradoxical. A slight improvement in it while raising initially peasants' income discourages manufacturing and the urban sector, hence, it reduces urban labour absorption. Hence, the initial gain in peasants' income per head is rapidly eroded by greater rural labour absorption. The result must be taken in the light of a situation of extreme population pressure on the land.

Even though the external terms of trade are exogenous in the model, this is not the case with the terms of trade between tradables and non-tradables within the domestic economy. These terms of trade, given a fixed exchange rate, are important in determining trends for the balance of payments to deteriorate or improve. Specifically, the model shows a situation in which endogenous forces , e.g. internal migration and government expenditure, tend to produce recurrently a high relative price of non-tradables. This contributes to the deterioration of the balance of payments by promoting an over expansion of a sector which does not generate exports, while induces the consumption of imports. In addition, it reduces the stimulus for the manufacturing sector to develop.

Table 5.4--Parameters Specifications BCASE2 and BCASE3

Fertility Specification BCASE3

$$CBRR = \frac{BIRTHR1}{COBFR} + BIRTHR2$$

$$COBFR = \left(\frac{Y+LAG(Y)}{2}\right)^{1.5}$$

CBRR=Rural crude birth rate

BIRTHR1=Parameter (28000)

COBFR=Artifact

BIRTHR2=Lower CBRR asymptote (24)

Y=Income per capita (t)

LAG(Y)=Income per capita (t-1) (CBRU) equation follows:

$$CBRU = \frac{BIRTHU1}{COBFU} + BIRTHU2$$

where;

CBRU=Urban crude birth rate

BIRTHU1=Parameter (330)

COBFU=Artifact

BIRTHU2=Lower CBRU asymptote (18)

$$COBFU = \left(\frac{Y+LAG(Y)}{2}\right)^{0.6}$$

Fertility Specification BCASE2

Below the threshold, the specification is the same as the specification BCASE1 below the threshold. Above the threshold, it has the same functional form as BCASE3. Only. the rural parameters change:

$$COBFR=\left(\frac{Y+LAG(Y)}{2}\right)^{0.5}$$

BIRTHR1=Parameter (280)

BIRTHR2=Lower CBRR asymptote (24)

$$COBFU=\left(\frac{Y+LAG(Y)}{2}\right)^{0.6}$$

BIRTHU1=Parameter (330)

BIRTHU2=Lower CBRU asymptote (18)

6. SIMULATION EXPERIMENTS ON ALTERNATIVE POLICY SCENARIOS

INTRODUCTION

The model has been shown to replicate reasonably well the stylized facts of development for the hypothetical African economy under consideration. This gives us some interest in using the model to simulate alternative policy scenarios and to examine its implications for the economic-demographic results in the year 2000.

The use of the model in policy analysis, however, faces some methodological issues which is convenient to clarify. The most important one, is that two alternative specifications of fertility are able to reproduce into some extent the stylized facts of development. These alternative specifications, however, could lead to different policy assessments. [194]

In particular, the model using the fertility specification (BCASE1) replicates better the stylized facts and demographic trends of our scenario, until the moment in which the actual fertility pattern changes significantly and unexpectedly in 1988. This change corresponds actually to Kenya's unexpected fertility decline in 1988, whose veracity is still debated. [195]The model using the fertility specification BCASE2, predicts better this change in the fertility pattern, even though, its general replication of other socioeconomic changes is weaker.

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[194] The alternate specification of fertility as a declining nonlinear function of income per capita did not replicate well the stylized facts of the modeled economy, thus, it is not used on further policy analysis.

[195]Several sources, indeed, present good arguments for disregarding its veracity. See Page (1990) in "The State of African Demography", published by the UNFPA.

In view of the above, we have chosen to replicate some of the policy experiments using both fertility specifications.

The second methodological issue relates to the role of assumptions in simulation models. Specifically, the results of a model are contingent on the assumptions regarding structural parameter values. The assumptions of this model have not been tested in the traditional statistical sense. [196] Instead, we have relied upon the model's ability to reproduce the stylized facts of development and demographic change in the region.

The first part of this chapter discusses policy experiments which use the fertility specification BCASE1. In order to avoid cumbersome references, we will denote this specification sometimes as the "quality of life fertility specification" [197]In the second part of the chapter, two crucial policy experiments whose results may be sensitive to this fertility specification are replicated using the alternative specification BCASE2. [198] This fertility specification is sometimes denoted as the "income fertility specification".

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[196] In fact, we did not had access to the data to do this.

[197] In this specification, fertility was assumed as a positive function of life expectancy and wage rates before a threshold level of development. Above the threshold level, fertility was specified as a negative function of life expectancy, the real wage rate and the proportion of skilled workers within the labour force. The details of this specification were provided before.

[198] In this specification, fertility is assumed as a negative function of income per head after a threshold of development is surpassed. The details were provided before.

6.1 Set of Policy Experiments Using the Quality of Life Fertility Specification

6.1.1 Downwards Wage Inflexibility in The Modern Sector

This policy scenario assumes a different "government rule" setting modern sector wages. This rule reflects the role of urban unions and/or government legislation in exerting a greater protection of wages in the urban modern sector. It entails less downwards flexibility of these wages relative to the basic case simulation.

It should be recalled that the "government rule" incorporated in the basic simulation case was to reduce modern sector wages in period t, if the informal sector had employed 30 percent or more of the urban labour force in period t-1. The reduction in the modern sector real wage was of such magnitude so as to reduce informal sector employment to 20 percent of the urban labour force in the subsequent period (t).

The rule is modified as follows: modern sector wages are reduced in period t, if the informal sector employed 60 percent or more, of the urban labour force in period t-1. The reduction is such as to reduce informal sector employment to 40 percent of the urban labour force.

In general, these government intervention rules seek to reduce modern sector involuntary unemployment and "underemployment" or employment in the informal sector. That is, within a period where supply and demand for informal and modern sector labour are given, a reduction in the modern sector wage increases employment in the modern sector and reduces employment in the informal sector, and raises its wage. Powerful unions and/or government social policies biased toward the modern sector, will manifest themselves in the form of "rules" being less sensitive toward the relative size of employment in the informal sector, and/or to the magnitude of the wage gap between both sectors. Different rules, though, have different dynamic implications on the economic-demographic evolution (Calvo, 1978).[199].

Main Results

The results displayed in table 6.1[200] depict a lower rate of growth of income per head, 0.9 percent per annum instead of 1.6 in the basic simulation case. The income per head index (100 in 1970) rises to 131 by the year 2000, instead of to 161 as in the basic simulation case (BSC).

A greater level of external indebtedness also results in this new scenario. External debt has risen to 177 percent of GDP instead of 120 percent in the BSC. The structure of the external debt is also different, with a greater share of it due to the government debt. Finally, the rate of population growth is virtually the same in both cases.

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[199] In dynamic terms, labour demand and supplies curves shift determining a particular evolution of relative real wages and, hence, employment in the informal and formal sectors.

[200] All tables of results come at the end of the respective sections. The complete model results are available in the Population Research Laboratory of the University of Alberta.

The lower rate of economic growth arises from the lower growth of the GDP of the urban sectors. That is, value added in manufactures and services grow in this simulation at 5.8 and 4.9 percent annually, respectively, whereas they had grown at rates of 7.0 and 5.5 percent, respectively, in the basic simulation case. Agriculture continues to grow at a similar rate of 2.7 percent per annum.

The rate of growth of urban areas is also lower, 5.9 percent instead of 6.8 percent, which is due largely to a marked reduction in rural-urban migration. The composition in the migration flow is also different; the proportion of skilled workers in the urban labour force has increased to 64 percent, instead of 60 percent in the basic simulation case.

Reversals in the rural-urban flow of migration obtain in this simulation in several periods. Indeed, the probability of modern sector employment for unskilled workers in this case has fallen dramatically, being zero for about 18 periods instead of 4 periods in the basic simulation.

The pattern of labour absorption also changes. In urban areas, employment grows faster in services than in manufactures, 6 and 5.1 percent, respectively, contrary to the BSC case. This reflects what is called "overurbanization" in the development literature (Gugler, 1988). In rural areas, employment grows at a 2.8 percent rate, in comparison to 2.5 percent in the basic simulation case.

One paradoxical result is that the average urban real wage declines less than in the basic simulation. The composition of the average evolution is in this case different, though. That is, the modern sector real wage remains practically constant while that of the informal sector falls. In the BSC both fell. Specifically, the informal sector real wage is, on average, along the thirty years of the simulation, slightly slower than in the BSC.

The decline in rural real wages is similar to the one in the BSC. In this case, agricultural labour productivity declines slightly more while the price index rises less. [201] At the national level, the average real wage between urban workers and peasants, rises by a 5 percent approximately, markedly less than in the BSC case, 19 percent. Hence, the income distribution worsen in this scenario.

In demographic terms, the rate of urban natural increase is this time lower and the rate of rural natural increase virtually the same as in the basic simulation case. Because of the lower level of urbanization, 26 percent versus 34 percent in the BSC, the weight of the urban rate of natural increase on the national rate of natural increase is also lower. Thus, the national rate of natural increase obtained is approximately the same as in the BSC.

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[201] The lower flow of internal migration produces a lesser rise in services and housing prices than in the BSC.

Analysis of the Results

The explanation of these results is of the same nature as the one used to explain the BSC outcomes. Hence, only the bare essence of it will be provided.

The higher modern sector real wage influences the economic-demographic dynamics through the following mechanisms. It reduces labour absorption by the modern sector. It also determines a lower rate of profits. The reduction in profits, in turn, reduces the rate of investment and capital formation, which explains in part why growth of the economy slows.

The resultant lower rate of capital formation reduces the demand for modern sector labour, hence, depressing further modern sector labour absorption. The lower rate of employment creation reduces employment probabilities thus, reducing ultimately the rural-urban migration flow.

The reduction in employment probabilities is greater for unskilled than for skilled workers. This is so because the lower rate of absorption of skilled workers leads them to displace unskilled workers from modern sector jobs at a greater rate than in the BSC --the job bumping character of the model. This, in addition to the relatively greater fall in the informal wage rate in this simulation, produces the change in the skill composition of internal migration.

The decline in internal migration reduces efficiency gains derived from shifting labour from agriculture to the urban areas. It also worsen the distribution of income, and reduces the rate at which consumption shifts out of food. Thus, it contributes through demand factors to a slow down in the growth of the productive urban sectors.

The rate of growth of agricultural production does not decline because rural labour increases significantly.

The above results depend on the fact that the real wage in the modern sector does not fall as much as in the BSC. This, in turn, depends of the informal sector not growing explosively, which would produce a government intervention to reduce modern sector wages.

In fact, the higher wage rate in the modern sector has determined an initial faster relative increase of employment in the informal sector. This increase is fast in relation to that of the BSC, but not fast enough to increase informal sector employment relative to the urban labour force to the point where modern sector wages are reduced. The faster relative increase in employment in the informal sector, though, has reduced rapidly the wage rate in this sector. This effect, as explained below, slows the relative growth of the sector. On the other hand, the lower labour absorption by the modern sector has reduced modern sector employment probabilities, especially the ones of unskilled workers. In fact, the latter probabilities have become zero in most periods.

Thence, the expected urban wage for unskilled workers has become equal to the informal sector wage. To put it in another way, the expected wage for unskilled workers in the modern sector has become less than the informal sector wage. The latter has fallen and is barely greater than the rural wage plus the urban cost of living. This effect explains mainly the reduction in the rural-urban migration flow. The reduction in expected urban wage for the skilled workers is of secondary importance. It is worth noting that the reduction in the informal wage does not need to be extreme to produce this result. Most important is the drastic reduction in modern sector employment probabilities. This is why the urban average real wage is in this simulation higher than in the basic simulation case.

The reduction in the rural to urban migration flow is sufficient to slow the rate at which employment in the informal sector increases relatively to urban employment.

6.1.2 Policy Guidelines

This policy scenario illustrates the dramatic consequences of setting real wages by institutional or other means at levels above equilibrium. This problem, in particular for Africa, has been reported elsewhere. Obvious policy guidelines are those of liberalizing urban labour markets. This liberalization should lead, in sum, to both stronger economic growth and better income distribution.

A further degree of liberalization in the labour market leads to more internal migration and urbanization. Rising urbanization, in turn, offsets and even may reverse the effect that a rising rate of rural population growth has on the national rate of natural increase. In the very long term, e.g. 60 years, assuming that urbanization continues at the pace of the basic simulation case and urbanization levels rise to 70 percent, the rate of growth of population will decline mildly. It will decline roughly to a rate of 2.6 percent. On the contrary, if the speed of urbanization slows down, this meager result would be delayed to a more distant future.

The greater flexibility exhibited by real wages in the labour market does not affect greatly the rate of population growth over the time horizon of the simulation exercise. That is, the economy cannot generate a significant improvement in the living conditions of the population by the year 2000, except in the case where one assumes unrealistically high rates of economic growth. Hence, a significant decline in fertility is unlikely to take place by the year 2000. The point will be illustrated in the next simulation.

A faster pace of economic growth means that a significant rise in living conditions will take place in a less distant future than would otherwise have been the case. Most importantly, the possibilities for the government to provide health and education are compromised by a reduction in the rate of economic growth which arises from a greater inflexibility in modern sector wages. This is a crucial issue for the health agenda in Africa today (McNamara, 1985).

An alternative policy tool which produces similar effects to setting modern sector wages above equilibrium is to reduce rural-urban migration. These policies e.g. "the return to the land" practiced in some African countries not only reduce economic growth and worsen income distribution, but for the same reasons noted above may also delay the possibilities for a demographic transition to take place (Adepoju, 1988, Simmons, 1977).[202]

Policies which tend to discourage the informal sector, without creating alternative sources of urban employment also lead to a similar result. The existence of the informal sector, in general, facilitates internal migration and as such facilitates income distribution and economic growth (Linn, 1983).

In general, the above guidelines shed light on the discussion of "overurbanization" in developing countries (Gugler, 1988; Todaro and Stilkind, 1981). This is understood as the rapid relative enlargement of services employment driven by rapid population growth and/or rapid rural-urban migration. Indeed, the simulations show that this relative enlargement does take place when there is less inmigration in circumstances in which the rates of population growth are the same. It also shows that the relative enlargement of employment in informal services takes place ultimately because the rate of economic growth is low rather than because the rate of population growth being high. To put it in another way, rapid internal migration obtains mostly because of "pull" rather than because of "push" forces. Finally, it also shows that employment in services, even when informal services are deregulated, does not "explode", but regulates itself, contrary to what has been suggested sometimes in the Neo-Malthusian literature (Williamson, 1988; Gregory, 1980; Udall, 1976).

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[202] This is not contradictory with the fact that higher real wages in the urban modern sector, a symptom of repressed rural-urban migration, reduce urban fertility. Artificially higher modern sector wages, however, by producing a lower rate of growth of the economy reduce internal migration. This, in turn, prevents a faster decline in the national fertility level because rural fertility is substantially higher than urban fertility.

In sum, "overurbanization" must be understood in relative terms more akin to Marxian conceptions of relative surplus population than to Neo-Malthusian conceptions of it. That is, the concept is relatively independent of population pressure. In other words, Third World countries may "overurbanize" even in the absence of rapid population growth (Gugler, 1988; Mohan, 1984).

This policy scenario suggests that commonly observed lower fertility and mortality in urban areas might be due to the very "institutional distortions" protecting income conditions of urban workers. Further, it also suggests that these demographic conditions are achieved at the expense of more poverty in the country side. A condition which, in itself, perpetuates a regime of high population growth.

This casts some doubts on optimistic demographic views on Africa, which see in the existence of lower urban fertility levels the proof that modernization is already starting to reduce fertility (World Bank, 1984, Faruquee and Gulhatti, 1983). As explained above, lower urban fertility might constitute an indication of the very difficulties for the emergence of the demographic transition.

The simulation highlights some macro aspects faced by health policies in African countries. It suggests that efforts to improve living standards in the modern sector have been done at the expense of living standards in the country as a whole; indeed, such efforts may actually impede raising the general living standard. On the other hand, it confirms the frequently quoted case that rapid rural-urban migration can lead to a rise in mortality in urban areas. The solution to this problem, however, is not to reduce internal migration (Adepoju, 1988).

TABLE 6.1

EXPERIMENT OF DOWNWARDS WAGE INFLEXIBILITY IN MODERN SECTOR

VARIABLE	BASIC CASE RESULTS			WAGE INFLEXIBILITY RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP or National Income(a)-	5%	455	2086	4.3%	455	1637
Population	3.4%	5181	14340	3.38%	5181	14346
Income per head(c) . .	1.6%	100	161	0.9%	100	131
Food per head production (index) . .		100	76		100	72
Urban Population . . .	6.8%	637	4856	5.9%	637	3753
Urban %		12%	34%		12%	26%
Rural Population . . .	2.5%	4544	9483	2.8%	4544	10616
Rural %		88%	66%		88%	74%
External Balance Variables						
Deficit as % of GDP(d)		8.7%	15.5%		8.7%	20.5%
Average Deficit . . .	8.4%			11%		
Foreign Debt as % of GDP(d)	4%	35%	120%	5.4%	35%	177%
Production: Sectoral Shares in GDP						
Agriculture	2.6%	39%	19%	2.7%	39%	24%
Manufactures	7.0%	14.7%	28%	5.8%	14.7%	23%
Services	5.5%	36%	42%	4.9%	36%	42.5%
Housing	5.3%	6.4%	7%	4.6%	6.4%	7.1%
Construction	4.3%	3.5%	2.9%	4.3%	3.5%	3.4%

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VARIABLE	BASIC CASE RESULTS			WAGE INFLEXIBILITY RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment						
Agriculture	2.5%	88%	67.2%	2.8%	88%	74%
Manufactures	7.5%	2%	6.9%	5.1%	2%	3.6%
Services	6.5%	10%	25%	6%	10%	22.4%
Housing	b	b	b	b	b	b
Construction	b	b	b	b	b	b
Changes in Real Wages and Prices (e)						
	% Change					
Urban Average Wage . .	-34%	220	149	-29%	220	157
Urban Modern Wage . .	-26%	152	112	+1%	152	153.7
Urban Informal Wage .	-36%	109	70	-47%	109	58.2
Rural Wage	-23%	31	24	-25%	31	23.2
National Average . . .	+19%	53.7	66.5	+5%	53.7	56.5
Price Index		1	8.9		1	8.63

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VARIABLE	BASIC CASE RESULTS			WAGE INFLEXIBILITY RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Human Capital Variables (real expenditure and consumption per head: quantities)						
	% Change					
Urban Food Consumption	-28%	43.6	31.2	-25%	43.6	32.7
Rural Food Consumption	-11%	18.3	16.2	-15%	18.3	15.5
National Food Consp. .	5%	21.3	24.6	-7%	21.3	20
Urban Health Expend. .	+20%	7.3	8.8	+30%	7.3	9.5
Rural Health Expend. .	+63%	3.6	5.9	66%	3.6	6
Urban Skilled % . . .		45.7%	60%		45.7%	64%
Rural Skilled % . . .		27%	23%		27%	25%
Demographic Variables						
Urban Birth Rate . . .		40	33		40	31.2
Urban Death Rate . . .		10.4	10		10.4	9.5
Urban Life Expectancy		61.8	62.6		61.8	63.6
Urban Natur. Increase		2.95%	2.3%		2.96%	2.2%
Aver. Urban Nat.Incr.	2.7%			2.55%		
Inmigration Rate(f) .	4.1%			3.45		
C-D Development Index Rural		123	108		123	110
Rural Birth Rate . . .		52.9	54.7		52.2	54.6
Rural Death Rate . . .		18.3	14.3		18.7	14.4

VARIABLE	BASIC CASE RESULTS			WAGE INFLEXIBILITY RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables						
Rural Life Expectancy		47.5	54.7		46.6	54.7
Rural Natur. Increase		3.46%	4.04%		3.35%	4%
Aver. Rural Nat.Incr.	3.4%			3.7%		
Outmigration Rate(g) .	0.9%,			0.9		
National Birth Rate .		51.35	47.3		50.7	48.5
National Death Rate .		17.35	12.8		17.7	13.1
National Life Expec.		49.2	56.7		48.4	57
National Natur. Incr.		3.48%	3.45%		3.3%	3.5%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Inmigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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6.2 Accelerated Capital Accumulation and Technological Change

This policy scenario assumes exceptionally high rates of savings by capitalists and further technological innovation in the modern sector.

The rates of annual technological change are assumed to be 1.8, 0.6 and 1.2 percent, in manufacturing, construction and big farms, respectively. The other sectors do not experience technological change. Also assumed is a higher marginal propensity to save, 0.6, instead of 0.4 in the basic simulation case. The social policy of the government continues unaltered. That is, the same targets of health and education stated as a function of the rates of population growth, are maintained. All other conditions remain the same as in the BSC.

Strong Economic Growth in Spite of Rapid Population Growth

The results manifest clearly the new conditions. National income (GDP) grows this time at a 7.1 percent rate annually while population grows at a rate close to 3.4 percent. Thus, income per head grows by 3.7 percent annually. The index of per capita income rises to 303 by the year 2000. The corresponding index for the BSC was 161.

The external debt declines continuously, and the country obtains a surplus in its final balance of payments. Agricultural production per capita remains constant. In brief, the "population problem" vanishes, at least from an "economic growth" point of view.

Urbanization accelerates compared to the basic simulation case, which arises from the greater rate of economic growth. That is, urban areas grow now at a rate of 7.3 percent instead of 6.8 percent in the BSC. The urbanization level becomes 40 percent by the year 2000, in comparison to 34 percent in the BSC. Rural-urban migration increases considerably, contributing 67 percent of urban growth, instead of 61 percent in the BSC. Analogously, 40 percent of the new rural cohorts are syphoned off from agriculture, compared to 30 percent in the BSC.

The composition of rural-urban migration and its effects on the educational composition of urban and rural areas is also different. In rural areas, the percentage of skilled workers in the labour force declines from 27 to 20 percent, instead of to 23 percent in the BSC. In urban areas the corresponding percentage rises from 45 to 58 percent, instead of to 59 percent in the BSC.

The rates of growth of urban GDP rise markedly. That is, manufacturing grows at a rate of 10.7 percent, and services at one of 6.8 percent. Employment in manufacturing grows at 9.5 percent annually, while employment in services grows at 6.7 percent. The "overurbanization" pattern observed in the second experiment is reversed.

Is Fast Economic Growth Fast Enough?: The Demographic Implications

Now let us analyze the social indicators associated with this high rate of economic growth. The urban real average wage increases for the first time by 7 percent while the rural one remains constant. Overall, this represents a 108 percent increase in the national average real wage during the period. This result, compared to the corresponding 19 percent increase in the BSC, is remarkable. However, as explained below, this income improvement is insufficient to initiate a significant fertility decline at the national level.

The living conditions in urban areas have improved in relation to the basic and the previous simulations. Food consumption and real wages have increased for the first time. Education measured by the retention of skilled workers has increased as much as in the BSC.

Thus, in this case, the higher real wage and greater food consumption reinforce the effects of increased health expenditure,[203] medical technological change, and educational improvement on reducing mortality. In the BSC they counteracted the effect of the latter variables.

As a consequence, the urban crude death rate falls more than in all previous experiments. Indeed, it falls to 8 per thousand compared to 10 and 9.5 per thousand in the basic and wage inflexibility simulations, respectively. Life expectancy also rises to 66.2 years, compared to 62.6 and 63.6 years, in these previous simulations.

Urban fertility, determined by similar variables to the above, declines by more than in the previous simulations.

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[203] This is health expenditure in real terms.

That is, the crude birth rate falls to 28.3 per thousand while in the BSC and wage inflexibility case it fell to 33 and 31.2 per thousand, respectively.

The resultant rate of urban natural increase is on average 2.4 percent while in the BSC was 2.7 percent. During the simulation period, it has declined from almost 2.9 to 2 percent in comparison to a decline from 2.9 to 2.3 percent in the BSC.

In rural areas, the living conditions are also better than in the other cases, in the sense that neither food consumption nor the rural real wage deteriorate. Of course, these are not great conditions e.g. food consumption per head being half of that in the cities. However, they at least do not counteract the effects of government increased health expenditure by government in reducing mortality. The adult education decline counteracts this effect somewhat. In short, the rural crude death rate falls to 13.4 per thousand, which is less than that in the other simulations (14.3 in the basic case and the wage inflexibility case).

The improvement in rural conditions is not sufficient to initiate the decline in fertility. As suggested above, neither an increase in the real wage nor in food consumption has taken place. Moreover, education measured by skilled workers retention is now less than ever. Only life expectancy has increased more than in the other scenarios.

Under these circumstances, the developmental threshold beyond which rural fertility declines is not reached. Hence, the better life expectancy translates through a reduction in sub-fecundity into the highest rural fertility level of all previous cases. That is, the crude birth rate now rises to 55.3 per thousand instead of 54.7 per thousand in the BSC.

Hence, the rural rate of natural increase has increased from 3.4 to 4.2 percent by the end of the simulation. On average, the rural rate of natural increase has been 3.65 percent. The corresponding figures for the BSC were 3.4, 4 and 3.4, respectively.

In sum, the national rate of natural increase declines slightly in relation to the BSC. The reduced urban rate of natural increase and the higher level of urbanization have more than offset the effect of the greater rate of natural increase in rural areas.

6.2.1 Policy Guidelines

The above results suggest that even if the prototype African economies would have experienced strong economic growth during 1970-1990, and continue to experience it till the year 2000, a significant decline in fertility would not take place by the year 2000. This provocative policy result approximates somewhat the actual Kenyan experience, in which strong economic growth in the sixties and seventies was associated with a mild increase in fertility (World Bank, 1980; Anker and Knowles, 1983).[204]

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[204] Certainly, the model result is a product of the assumptions stating a positive response of fertility to modernization in rural areas. The assumption, however, tends to fit well with reality. See section 5.1.

The result might be also interpreted as a consequence of the slow rate of growth of real wages in a dualistic economy, until the rural surplus population is eliminated. That is, even though income per head grows rapidly real wages in rural and urban areas do not increase much. Thus, neither the need for large families due to pension motives is reduced nor the cost of children is reduced. This type of argument for explaining the maintenance of high fertility in dualistic economies is a robust proposition of economic approaches to fertility (Lindert, 1980, 1985).[205]

Accelerated urbanization, by increasing the weight of lower urban fertility in determining the national fertility level, would seem to be the most feasible possibility of reducing the rate of population growth. This simulation, however, highlights the limitations of urbanization as a vehicle for reducing national fertility.

Indeed, the run shows possibly the fastest rate of urban growth in an African scenario. This is so, because the rate of economic growth which drives urbanization is, in this case, close to the maximum possible for these countries. In fact, the rates of GDP growth for Kenya and the Ivory Coast were close to 7 percent during the sixties and part of the seventies (Ghai and Radwan, 1983). Yet, the simulated decline in the national rate of population increase by the year 2000 achieved through this high pace of urbanization is negligible, 3.3 percent, instead of 3.4 percent in the BSC approximately.

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[205] It is worth noting that the experiment assumes that the faster rates of educational and health expansion in Africa, take place. All previous experiments, indeed, use the Kenyan historical record in education and health expansion, which is one of the bests in Africa (World Bank, 1989).

Therefore, under this set of fertility assumptions (quality of life), this experiment highlights the need to use different means to accelerate the demographic transition, than leaving the task to economic development by itself.

This is partly due to the fact that the type of development is unbalanced and thus insufficient to produce the fertility decline. The imbalance manifests in the drain of educated manpower from the country side, which is induced by strong economic growth. This drain contributes to the maintenance of high rural fertility (Todaro, 1978, 1980). The imbalance is perpetuated by a peasants' sector which supports most of the population, but which remains backward due to limited access to capital and technological change and, all too often, due to inappropriate policy. In these circumstances, the rural sector cannot retain its more skilled and talented population, and thus strong economic growth tends to underdevelop it even further through the afore explained drain. It is worth noting that there may be other negative externalities associated with this drain e.g. lost of entrepreneurial capacity, dynamism and technological innovation. These externalities are not taken into account by the model.

The insufficiency refers to the almost impossibility for economic growth to produce a rapid improvement in real wages due to the dualistic conditions. The fact that labour income increases proportionately less than the income of capitalists is apparently unavoidable in view of the fast rate of population growth and the strong initial relative surplus labour concentrated in the country side. Policies attempting to correct the income distribution by using market mechanisms will achieve thus little. The only means to improve the income distribution at this stage of development are structural ones, e.g. land reform. [206]

These simulations point to the crucial need for reducing rural fertility. Given the quasi-impossibility for rural real wages to rise sufficiently in the midterm (30 years) in order to reduce pension motives (e.g. it would be required a doubling or tripling of the real rural wage rate), a perhaps most viable policy would be for the state to massively upgrade human capital formation in the country side.

In addition, these policies should look forward to mechanisms that ensure that investment in human capital, e.g. education, in rural areas remain in these areas, hence contributing to the reduction of rural fertility. Without a more complete economic transformation of the country side, though, it is difficult to increase skilled workers' retention in it. Indeed, under these circumstances, this retention only reduces economic growth.

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[206] Structural policy guidelines e.g. land reform, capital markets modification, are not discussed here because the model is basically not that flexible. On the other hand, the model was designed to discuss population policies mostly in a feasible rather than in an ideal framework.

TABLE 6.2

EXPERIMENT OF GREATER CAPITAL ACCUMULATION AND TECHNOLOGICAL CHANGE

VARIABLE	BASIC CASE RESULTS			G. CAPITAL ACCUMULATION RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP-National Income(a)-	5%	455	2086	7.1%	455	3844
Population	3.4%	5181	14340	3.38%	5181	14310
Income per head(c) . .	1.6%	100	161	3.7%	100	303
Index Food per head production		100	76		100	100
Urban Population . . .	6.8%	637	4856	7.3%	637	5660
Urban %		12%	34%		12%	40%
Rural Population . . .	2.5%	4544	9483	2.1%	4544	8649
Rural %		88%	66%		88%	60%
External Balance Variables						
Deficit as % of GDP(d)		8.7%	15.5%		7.3%	-5%
Average Deficit . . .	8.4%			-1.6%		
Foreign Debt as % of GDP(d)	4%	35%	120%	b	35%	-32%
Production: Sectoral Shares in GDP						
Agriculture	2.6%	39%	19%	3.4%	39%	13%
Manufactures	7.0%	14.7%	28%	10.7%	14.7%	44%
Services	5.5%	36%	42%	6.8%	36%	32.6%
Housing	5.3%	6.4%	7%	7.1%	6.4%	6.7%
Construction	4.3%	3.5%	2.9%	6.7%	3.5%	3.1%

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VARIABLE	BASIC CASE RESULTS			G. CAPITAL ACCUMULATION RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment						
Agriculture	2.5%	88%	67.2%	2.1%	88%	60.5%
Manufactures	7.5%	2%	6.9%	9.5%	2%	12.6%
Services	6.5%	10%	25%	6.7%	10%	24.1%
Housing	b	b	b	b	b	b
Construction	b	b	b	b	b	b
Changes in Real Wages and Prices(e)						
	% Change					
Urban Aver. Wage . . .	-34%	220	149	+7%	219	235
U.Mod.Sector Wage . .	-26%	152	112	-3%	152	148
U.Inf. Sector Wage . .	-36%	109	70	+31%	109	142.7
Rural Wage	-23%	31	24	-4%	31	29.7
Nation. Averag. . . .	+19%	53.7	66.5	+108%	53.7	111.5
Price Index		1	8.9		1	8.83

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VARIABLE	BASIC CASE RESULTS			G. CAPITAL ACCUMULATION RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Human Capital Variables (real expenditure and consumption per head: quantities)						
	% Change					
Urban Food Consumption	-28%	43.6	31.2	+13%	43.9	49.5
Rural Food Consumption	-11%	18.3	16.2	+2%	18.4	18.8
National Food Consp. .	5%	21.3	24.6	+44%	21.5	31
Urban Health Expend. .	+20%	7.3	8.8	+24%	7.3	8.9
Rural Health Expend. .	+63%	3.6	5.9	+72%	3.6	6.2
Urban Skilled % . . .		45.7%	60%		45.7%	58%
Rural Skilled % . . .		27%	23%		27%	20%
Demographic Variables						
Urban Birth Rate . . .		40	33		40	28.3
Urban Death Rate . . .		10.4	10		10.4	8.0
Urban Life Expectancy		61.8	62.6		61.8	66.2
Urban Natur. Increase		2.95%	2.3%		2.96%	2.02%
Aver. U.Nat.Incr. . .	2.7%			2.44%		
Inmigration Rate(f) .	4.1%			4.9%		
C-D Development Index Rural Fert.		123	108		126	115
Rural Birth Rate . . .		52.9	54.7		52.2	55.3
Rural Death Rate . . .		18.3	14.3		18.7	13.4

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VARIABLE	BASIC CASE RESULTS			G. CAPITAL ACCUMULATION RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables						
Rural Life Expectancy		47.5	54.7		46.6	56.4
Rural Natural. Incr. .		3.46%	4.04%		3.35%	4.18%
Aver. Rural Nat.Incr.	3.4%			3.65%		
Outmigration Rate(g) .	0.9%			1.5%		
National Birth Rate .		51.35	47.3		50.7	44.5
National Death Rate .		17.35	12.8		17.7	11.2
National Life Expec. .		49.2	56.7		48.5	62.3
National Natur. Incr.		3.48%	3.45%		3.3%	3.3%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Inmigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.

Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.

Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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6.3 The Exogenous Control of Population Growth: The Utopian Panacea

Simulation experiments showing how a lower rate of population growth increases[207] the rate of growth of income per head have somewhat lost their validity in part because they assume that an exogenous reduction in fertility is possible (Arthur and McNicoll, 1975). Also, they tend to be quasi-definitional (Sanderson, 1978).

In this experimental scenario, it is assumed that the initial crude birth rate in both rural and urban areas is reduced a point per year until reaching a lower asymptote. In urban areas, this asymptote is assumed to be 18 per thousand. In rural areas, the asymptote is assumed to be 25 per thousand.[208] Mortality is kept endogenous; hence, the rate of natural increase is also endogenous.[209] The chosen asymptote values are still on the high side, although, given African reality, they would be considered a demographic success if achieved.

Finally, all other assumptions are the ones of the BSC.

Main Results

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[207] For examples of these simulations, see Coale and Hoover (1958), Barlow and Davis (1974) and Casetti (1977).

[208] A second version was run assuming exogenous rural and urban rates of population increase. Only, the results of the first version are discussed.

[209] Both versions have obvious demographic errors. Indeed, it is not possible to control the size of the crude birth rate, even though, fertility could be controlled. It might be equally or worse than to assume that the rate of population growth could be controlled. Though, this is an speculative abstract experiment, and the underlying idea is that the crude birth rate is really an indicator of fertility. It is convenient to remind that the model does not consider age-structure.

The rate of growth in GDP is 4.3 percent, and the rate of population growth is 2 percent. Thus, the rate of growth of income per head is 2.3 percent, higher than that of 1.6 percent in the BSC. The index of income per head rises to 19[illegible] by the year 2000 in comparison with 161 in the BSC.[210]

The external debt also grows less, from 35 to 90 percent of GDP in 1997, instead of 35 to 120 percent. In the composition of the external debt, the government debt (GDEBT) in real terms is 42 percent of the government debt in the BSC. The trade debt (DEBT) is 76 percent of the corresponding one in the BSC.

In the urban sectors, manufacturing production grows at 6.7 percent while services grow at 4.6 percent. The respective values for the BSC were 7 and 5.5 percent. Employment in manufacturing grows at 6.8 percent and in services it grows at 5.1 percent. In the BSC, instead, they grew at rates of 7.5 and 6.5 percent, respectively. It is worth noting that production and employment tend to grow in manufacturing proportionally faster than in services in this simulation, in relation to the BSC. The greater absolute growth of both sectors in the BSC is due to the greater rate of population growth.

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[210] The noticeable increase in the rate of growth of income per-head due to population reduction, constitutes an exaggeration of reality in this model. This is due to the assumption that the labour force and the population grow at the same rate. Models, in which changes in fertility affect the size of the labour force with a lag of e.g. 15 years, in general, produce no effect on the economy until 15 years later.

The greater relative growth of manufacturing production and employment, in relation to that of services in this simulation, reflect the effect of a greater rate of growth of income per capita but also the relatively independent effect of a faster rural-urban migration. These effects move the economy out of a path characterized by a greater share of services in employment and production in the BSC, which we have associated with "overurbanization" .

In fact, 75 percent of the 5.6 percent rate of growth of urban areas corresponds to internal migration, in comparison to 60 percent in the BSC, and 67 percent in the case of rapid capital accumulation.

The lower absolute rate of population growth in urban areas, [211] 5.6 percent instead of 6.8 percent in the BSC, is due to the lower national rate of natural increase, 2 percent, instead of 3.4 percent in the BSC. It is worth noting, though, that the rate of population growth of urban areas is in this case 2.75 times the one of the whole population. In the BSC, it is 2 times. Thus, the rate of urbanization is higher in this case.

Why is the contribution of inmigration to urban growth so high in this case? In simple terms, it is higher than that of the BSC because the rate of growth of income per head is greater. However, this cannot explain why it is higher than that of the simulation with the strongest rate of increase of income per head.

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[211] This term is used here synonymously with "growth of urban areas"

The explanation arises from the relatively independent effect of the demographic change in itself, and partly to the manner in which the dynamics of the demographic change affects the rate of growth of income per head.

Indeed, in this case the natural rate of increase in urban areas is markedly less than in other cases. Hence, the indigenous [212] growth of the urban supply of workers is also markedly less. This may translate into a faster growth of the urban capital to labour ratio, hence, in a faster growth of the urban demand for labour while the growth of the indigenous labour supply is lower. This is why the rate of inmigration, or the contribution of rural to urban migration to urban growth, is greater in this case than in the BSC. In the case of capital accumulation, both the demand for urban labour and the indigenous supply of urban labour grow faster than in this simulation. Thus, the greater inmigration rate of this simulation is a product solely of the smaller indigenous growth of the urban supply of urban labour. [213]

The rate of growth of agriculture production becomes 2 percent, instead of 2.6 percent in the BSC. The rate of growth in agricultural employment is also smaller, 1.1 percent, instead of 2.5 percent in the BSC. The index of food production per head remains 100, while in the BSC it deteriorates to 76.

---

[212] This is the growth of the urban labour force in the absence of internal migration.

[213] There are additional factors contributing to this outcome. For instance, the lesser urban population reduces the rise in the price of housing relative to other prices in comparison with the other simulations. Hence, the urban cost of living is relatively lower than in the other simulations. The fact that the rate of population growth is also falling in the country side, and thus income per head is rising there, is also contributing.

The real urban average wage has fallen less than in the BSC. The real rural wage has remained practically constant. The resultant national average real wage increases by 40 percent instead of 19 percent in the BSC. Thus, the income distribution has improved in this case.

6.3.1 Policy Guidelines

This experiment shows a predictable effect of reducing population growth in a framework of high concentration of the population in the country side and relative scarcity of land. The outcome is a rise in the rate of growth of income per head.

The reduction in the rate of growth of population tends to increase the share of income derived by labour, or to improve the income distribution without reducing the rate of growth of the economy. In that sense, the poor in an open economy and in the very long run will be clearly better off with a lower than a higher rate of population growth. [214]

In this framework, the reduction in the rate of growth of population ensures a way out of the inner route towards stagnation of this economy, and toward the improvement in people's welfare. This should not be interpreted, however, in the sense that a reduction in the rate of population growth is the only option to get out from the route towards stagnation and to improving people's welfare. Nor, it should be interpreted in the sense that rapid population growth is the only cause of economic stagnation and people's poverty in the African scenario.

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[214] This does not mean that for a peasant family it is convenient to reduce his family size, in view of mounting population pressure on the land. Further, provided there are inter-generational transfers, it might be convenient even to increase its fertility size. See the "prisoner dilemma" (World Bank, 1984).

The fact that strong rural-urban migration reduces considerably the rate of growth of agriculture production, reflects somewhat the rural-urban imbalance of this type of development (the rate of growth of agricultural production is reduced from 2.6 to 2 percent).

It also highlights the need for increased technological change in agriculture. This would reduce the amount by which production in the sector declines when strong rural-urban migration takes place. Successful industrialization in these countries depends initially on their ability to maintain the agricultural exportable surplus. Rapid urbanization also depends on agriculture's capacity to feed the rising urban population. Otherwise, mounting external debt and lastly a reduction in the rate of economic growth would follow.

Indeed, this simulation shows that the above reduction in agricultural production is an important factor impeding a better external debt performance.

TABLE 6.3

EXPERIMENT OF FERTILITY CONTROL

VARIABLE	BASIC CASE RESULTS			FERTILITY CONTROL RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP-National Income(a)-	5%	455	2086	4.3%	455	1674
Population	3.4%	5181	14340	2%	5181	9485
Income per head(c)	1.6%	100	161	2.3%	100	199
Index Food per head production		100	76		100	100
Urban Population	6.8%	637	4856	5.6%	637	3432
Urban %		12%	34%		12%	36%
Rural Population	2.5%	4544	9483	1.1%	4544	6052
Rural %		88%	66%		88%	64%
External Balance Variables						
Deficit as % of GDP(d)		8.7%	15.5%		8%	8.4%
Average Def.	8.4%			6%		
Foreign Debt as % of GDP(d)	4%	35%	120%	3.2%	35%	90%
Production: Sectoral Shares in GDP						
Agriculture	2.6%	39%	19%	2%	39%	19.5%
Manufactures	7.0%	14.7%	28%	6.7%	14.7%	30%
Services	5.5%	36%	42%	4.6%	36%	39%
Housing	5.3%	6.4%	7%	5%	6.4%	7.7%
Construction	4.3%	3.5%	2.9%	3.5%	3.5%	3%

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VARIABLE	BASIC CASE RESULTS			FERTILITY CONTROL RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment						
Agriculture	2.5%	88%	67.2%	1.1%	88%	64%
Manufactures	7.5%	2%	6.9%	6.8%	2%	8.5%
Services	6.5%	10%	25%	5.1%	10%	25.6%
Housing	b	b	b	b	b	b
Construction	b	b	b	b	b	b
Changes in Real Wages and Prices (e)						
	% Change					
Urban Average Wage	-34%	220	149	-21%	220	174.5
Urban Modern Wage	-26%	152	112	-18%	152	124.8
Urban Informal Wage . . .	-36%	109	70	-26%	109	81.1
Rural Wage	-23%	31	24	0%	31	31.3
Nation. Averag.	+19%	53.7	66.5	+54%	53.7	83
Price Index		1	8.9		1	8.5

VARIABLE	BASIC CASE RESULTS			FERTILITY CONTROL RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Human Capital Variables (real expenditure and consumption per head: quantities)						
	% Change					
Urban Food Consumption . .	-28%	43.6	31.2	+17%	43.6	36
Rural Food Consumption . .	-11%	18.3	16.2	+4.5%	18.4	19.1
National Food Consumption.	5%	21.3	24.6	+17%	21.3	25
Urban Health Expend. . . .	+20%	7.3	8.8	+19%	7.3	8.7
Rural Health Expend. . . .	+63%	3.6	5.9	+66%	3.6	6.0
Urban Skilled %		45.7%	60%		45.7%	58%
Rural Skilled %		27%	23%		27%	18.3%
Demographic Variables						
Urban Birth Rate		40	33		40	18
Urban Death Rate		10.4	10		10.4	9.4
Urban Life Expectancy . .		61.8	62.6		61.8	63.8
Urban Natur. Increase . .		2.95%	2.3%		2.96%	0.8%
Aver. U.Nat.Incr.	2.7%			1.4%		
Inmigration Rate(f) . . .	4.1%			4.2%		
C-D Development Index Rural		123	108		123	97
Rural Birth Rate		52.9	54.7		53	25
Rural Death Rate		18.3	14.3		18.7	14

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VARIABLE	BASIC CASE RESULTS			FERTILITY CONTROL RESULTS		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables						
Rural Life Expectancy . .		47.5	54.7		46.6	55.6
Rural Natur. Increase . .		3.46%	4.04%		3.4%	1.1%
Aver. Rural Nat.Incr. . .	3.4%			2.3%		
Outmigration Rate(g) . . .	0.9%			1.2%		
National Birth Rate . . .		51.35	47.3		51.4	22.5
National Death Rate . . .		17.35	12.8		17.7	12.3
National Life Exp.		49.2	56.7		48.5	58.5
National Natur. Incr. . .		3.48%	3.45%		3.4%	1%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Inmigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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6.4 Basic Needs Policies

Basic needs policies seek to increase the quality of life in rural areas to a threshold, after which fertility starts declining. From then onwards, the decline in fertility, by initiating a reduction in the rate of population growth and, hence, raising income per head should reinforce itself.

The only realistic improvement in the quality of life which a poor Third World and mostly rural economy can induce in the medium-term, 15-20 years, is to basically upgrade health and education. In order for this upgrading to raise the quality of life effectively and, thus, to reduce fertility, it is minimally necessary to avoid a decline in the endogenous determinants of mortality. In addition, it is necessary to ensure that at least part of the rural expanded human (educated) capital remains in rural areas. [215]

The policy entails specifically doubling the rate at which health expenditure per head increases. That is, health expenditure is planned to increase at a total rate equal to four percent plus the rate of natural increase. This, of course, has to be a real expenditure increase. [216] Educational expenditure per head, in turn, is planned to increase at a rate of 4 percent in rural areas and 3 percent in urban areas.[217]

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[215] Mortality and fertility are basically reciprocal Cobb-Douglas functions. Thus, a decline in the endogenous demographic determinants of them, real wages, food consumption, percent of skilled workers in the labour force, would produce the failure of the basic needs attempt.

[216] In all other runs, health expenditure increased at a 2 percent rate plus the rate of natural increase.

These policies face several constraints. On the political side, it is impossible to erase the traditional "urban bias" favoring human capital upgrading in urban areas.[218]. Specifically, the biased health expenditure allocation favoring urban areas cannot be totally eliminated.

On the economic side, these policies require considerable financial resources, which are limited. That is, the country cannot obtain more foreign resources than the ones obtained in the BSC. If this constraint is not respected the policy would fail, e.g. international financial agencies would intervene demanding economic structural adjustments. This is a fairly typical case in the Third World. For instance, Tanzania and, to some extent, Ghana are close and recent examples.

The policy is financed by a tax of ten percent on profits, and expected additional funds generated by economic growth itself and the pay off associated with population reduction.

The policy assumes modernization conditions similar to the case of accelerated capital accumulation (ACA), albeit more realistic. The capitalists marginal propensity to save was reduced to 0.5 instead of 0.6. In addition, it was assumed that the government must spend on technological innovation approximately 0.5 percent of sectoral GNP. Technological innovation in the small farms sector was assumed to be a direct function of skilled workers retention. This assumption generates negative technological change if there is strong rural-urban migration and positive technological change with an upper limit of 1 percent annually, if there is a sharp increase in the proportion of skilled workers. The assumption of a positive relation between technological change and peasant's education is often mentioned as a realistic assumption in the development literature (Anker and Knowles, 1983; Eicher, 1984).

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[217] In the other runs, these rates were 2.7 and 1.4 percent, respectively. These rates have a direct but less than proportional relation with the "natural policy increase rates" of skilled workers in urban and rural areas. The latter being the rates at which skilled workers increase in the absence of internal migration effects.

[218] See Michael Lipton (1977).

These basic needs policies constitute, indeed, a mixture of conditions to generate economic growth and productive income redistribution. That is, redistribution which leads to an increase in the productivity of the poor. In this sense, they correspond mostly with the World Bank view of basic needs rather than with more radical views of them. The mixture is done precisely because these policies in the absence of economic growth would obviously fail, as it was pointed out before.

To what extent the simulation of these policies constitutes a realistic and valid exercise, is a complex question. On the one hand, we, indeed, criticize later the naivete of assumptions which permit income redistribution to take place simultaneously with greater capitalist investment and high rates of technological change. Indeed, the political economy experience of basic needs experiments is that if the involved income redistribution is substantial, elites' resistance generally accomplishes a reduction in both the investment rate and technological change rates (Todaro, 1985; Streeten et al, 1981). In view of this, a basic needs policy experiment in which both the savings rate and the rate of technological change in the modern sector is reduced, is presented in the next section.

On the other hand, most economic demographic models show generally experimental simulations in which raising education reduces fertility (e.g. Bachue Kenya, Bachue Philippines). The negative effect of education and positive effect of infant mortality on fertility constitute perhaps the most robust proposition of the demographic-economic theory of fertility (Birdsall, 1977; Birdsall et al, 1979). We have been critical of these experiments (chapter three) on grounds that they assume generally e.g. that the educational expansion is costless. That is why, we modeled more realistically the important costs associated with this policy. Furthermore, in our fertility specification BCASE1, these costs are enhanced due to the inverted u type of relation between modernization (education, health, nourishment) and fertility. This provides a framework to judge the realism of our basic-needs policies. Finally, a basic-needs policy experiment which assumes that fertility is not affected by education and health measures is also presented in the next section.

6.4.1 Three Basic Needs Experiments: Policy Discussion

Three basic needs experiments were done. In experiment 1 all conditions above apply.[21] In experiment 2 the rates of technological change are assumed to be the same as in the BSC, all other conditions remain the same as in the previous experiment. Finally, in experiment 3 restricted rural to urban migration of skilled rural workers is assumed. This is done by reducing their mobility parameter by half. All other conditions remain the same as in the first experiment. These experiments are herein compared with the BSC first and then among themselves. The results are summarized in table 6.4.

Main Results

These three experiments share the following significant results. The rates of economic growth are high: that is, income per capita grows at rates of 4 , 2.5 and 3.4 percent for experiments 1, 2 and 3, respectively. The corresponding rate in the BSC was 1.6 percent. The rate of population growth in the three experiments is reduced, from 3.3 percent in 1970, to approximately 2.2 percent in the year 2000. In comparison, in the BSC, the rate of natural increase remains at 3.4 percent by the 2000. In terms of absolute population[220], this rises from 5.1 to 12.9 million between the years 1970-2000 in experiment 1, to 12.6 million in experiment 2, and to 12.2 million in experiment 3, respectively. Finally, in the three runs, the foreign debt is reduced. With some variations, the three basic needs simulations have produced a better income distribution than the one in the BSC.

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[21] That is, health expenditure per head is planned to increase at 4 percent annually (in real terms). Its rural-urban distribution remains somewhat biased to urban areas. They receive a share equal to the urban percent of the population plus 10 percent of total health expenditure. Educational expenditure per head is planned to increase annually at a rate of 4 percent in rural areas and 3 percent in urban areas. The rates of technological change in manufactures, construction and big farms are assumed as 1.8, 0.6 and 1.2 percent, respectively. Technological change in small farms is assumed as a positive function of skilled workers retention with a maximum value of 1 percent. The marginal propensity to save of capitalists is assumed as 0.5. There are taxes imposed on profits equal to 10 percent.

Let us now analyze these experiments among themselves. Experiment 1, with equal conditions to experiment 3, except that skilled inmigration was not restricted, achieved a greater rate of economic growth, more urbanization, less external debt and a greater improvement in the income distribution.

There are demographic differences between these two experiments. Basically, the national rate of natural increase (NRNI) in experiment 3 increases slightly faster in the first 10 periods. This is a consequence of a lesser rate of urbanization. In the next ten periods, the NRNI of experiment 3 declines while in experiment 1, it is still increasing slightly. This is a result of the fact that the rural rate of natural increase in experiment 3 starts declining in period 11. From then onwards, the NRNI of experiment 1 starts declining rapidly reaching the magnitude of the NRNI of experiment 3.

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[220] This is population of workers.

The earlier decline of the NRNI of experiment 3 with respect to experiment 1, is due to the assumption regarding the retention of skilled labour.[221] The fact that after approximately period 20, the NNRI of experiment 1 converges rapidly to the value of the NNRI of experiment 3, is because both education and life expectancy improvements are assumed to achieve decreasing returns in reducing fertility after a certain point. This stage has obviously been achieved earlier in experiment 3.

The apparent advantage of experiment 3 in reducing fertility first, is only marginal. That is, the total population in this experiment reaches 12.2 million by 2000 while in experiment 1 it reaches 12.9 million. In short, the economy in experiment 1 has grown faster because of greater rural to urban migration in spite of a greater rate of population growth. Rural to urban migration is less in experiment 3 because the relative lower rate of growth of the urban supply of skilled workers has put upward pressure on wages relatively to experiment one.[222]

Experiment 2 indicates simply that even with a more normal technological situation in the modern sector, basic needs policies could still be applied successfully. That is, they could reduce fertility, external indebtedness and raise the rate of growth of per head income. The result in terms of economic growth is due mostly to the increased rate of technological change in the small-farms sector.[223]

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[221] The retention of skilled manpower is relative. That is, the mobility parameter of skilled is reduced by half.

[222] The lags and the the policy of relative skilled retention in the country side generates several interesting effects which would be too long to analyze here. For instance, involuntary skilled and unskilled unemployment in the modern sector are reduced and urban fertility is increased in experiment 3 relative to experiment 1.

6.4.2 Policy Guidelines

In the framework of the model assumptions, these simulations suggest that basic needs policies applied since the early 1970's would have initiated a substantive decline in fertility, and hence, in the rate of population growth in this African scenario before the year 2000.[224]

The policy insights provided by these simulations highlight the convenience of specific policies oriented to generate an improvement in the quality of life beyond market mechanisms, if a prompt reduction in African fertility levels is desired. Most importantly, the simulations suggest that basic-need policies can be, indeed, compatible with economic growth provided a combination of circumstances. This compatibility is given by the reinforcement that an early reduction in the rate of population growth can produce on the rate of economic growth of income per head. Further, if these policies achieve the reduction in the rate of population growth, they would lead also to an auto-sustained improvement on the income distribution.

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[223] It must be warned that the demographic changes in reality would take a longer time to work than what is suggested by these experiments. That is, fertility reductions will not affect the labour force until 10-15 years after they took place, contrary to mortality improvements. Thus, the above experiments might be viewed more realistically in the latter context. The underlying policy lines though are the same.

[224] Basic Needs Policies in the context of this research can be considered analogously to styles of development emphasizing human capital: education, health , nourishment. See Hicks (1980), Wheeler (1980) and Barlow and Davis (1974) models.

In a critical view, the combination of circumstances required for these policies to work may be deemed unrealistic. That is, even though, the simulations show that the financing of massive human capital accumulation could be generated internally by Third World countries themselves, this depends on critical assumptions. The greater taxation on capitalists' profits might be successfully resisted and even more realistically it can induce a reduction in the savings rate and a disruption on the continuity of technological change. In addition, the increase in the government capacity to finance the policies through the rise in the rate of growth of income per head, assumes that the reduction in fertility translates immediately into a reduction in the rate of growth of the labour force. Furthermore, these policies generate initially a rise in the rate of population growth, which with more realistic lags involved between the decline of fertility and that of the rate of growth of the labour force, could translate into an explosive external debt.

Therefore, these policies may require substantially greater foreign aid than that suggested by the simulations. Although, these increased external resources could be repaid later by resources generated by greater economic growth, induced, in turn, by the decline in the rate of population growth. In this vein, this analysis highlights the need for a conception of development, which should incorporate demographic and thus dynamic and/or very long terms perspectives on developmental aid and/or lending.

Reality is far apart from this. In fact, it is not likely that resources to finance basic needs policies will come from external sources. For instance, the current conditions in which Africa's foreign debt is being repaid are leading unavoidably to sharp reductions in health care and educational expenditure. Under these conditions, it seems obvious that the African demographic transition is being delayed. To be fair, basic needs policies are unlikely to be promoted sufficiently by most developing countries as well. This is so, because the elites of these countries may not be interested in these programs if they entail initial sacrifices of their wealth, as it is probably the case.

In a more technical aside, the basic needs experiments suggest that a vast field of dynamic optimization for economic-demographic policies is open. For instance, even though a policy reducing rural-urban migration of more skilled manpower may directly reduce economic growth, it also accelerates the onset of the fertility decline in the country side. In doing this, it also increases economic growth. The convenience of this policy, thus, depends ultimately on which of both effects is greater and ultimately on the timing involved for both to operate.

TABLE 6.4

COMPARISON AMONG THREE BASIC NEEDS POLICIES

VARIABLE	BASIC NEEDS 1			BASIC NEEDS 2			BASIC NEEDS 3		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP or National Income(a)	7%	455	3772	5.5%	455	2420	6.3%	455	3022
Population	3%	5181	12962	2.97%	5181	12634	2.9%	5181	12222
Income per head(c) . .	4%	100	332	2.53%	100	213	3.4%	100	277
Food per head production (index) . .		100	109		100	95		100	112
Urban Population . . .	7.3%	636	5722	6.7%	636	4824	6.6%	636	4618
Urban %		12%	44%		12%	38%		12%	37.8%
Rural Population . . .	1.5%	4544	7204	1.8%	4544	7809	1.7%	4544	7604
Rural %		88%	56%		88%	62%		88%	62.3%
External Balance Variables									
Deficit as % of GDP(d)		1%	-2%		3.6%	6.4%		0%	4%
Average Deficit . . .	0.4%			0.8%			2.9%		
Foreign Debt as % of GDP(d)	-7%	25%	3%	1.4%	30%	46%	1.5%	25.7%	40%
Production: Sectoral Shares in GDP									
Agriculture	3%	39%	13%	2.8%	39%	17.6%	3.35%	39%	16.1%
Manufactures	10.5%	14.7%	43%	8%	14.7%	32%	9.5%	14.7%	38%
Services	6.8%	36%	34.3%	5.8%	36%	40%	6.2%	36%	35%
Housing	b	b	b	b	b	b	b	b	b
Construction	b	b	b	b	b	b	b	b	b

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VARIABLE	BASIC NEEDS 1			BASIC NEEDS 2			BASIC NEEDS 3		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment									
Agriculture	1.5%	88%	56%	1.8%	88%	62%	1.7%	88%	62%
Manufactures	9%	2%	12.2%	7.9%	2%	9%	8.43%	2%	10%
Services	6.5%	10%	29%	6.2%	10%	26.5%	6.4%	10%	25%
Housing	b	b	b	b	b	b	b	b	b
Construction	b	b	b	b	b	b	b	b	b
Changes in Real Wages and Prices (e)									
	% Change								
Urban Average Wage . .	+5%	218	228	-13%	218	190	+5.5%	219	231
Urban Modern Wage . .	+b%	152	156	-14%	152	131.6	-3.2%	152	148
Urban Informal Wage .	19%	100	119	-5%	103	98	+36%	103	141
Rural Wage	+6%	31	33	+14%	31	35.1	+6%	31	33.6
National Average . . .	+123%	53.4	119	+76%	53.6	94	+102%	53.7	108.5
Price Index		1	8.95		1	8.39		1	9.1

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VARIABLE	BASIC NEEDS 1			BASIC NEEDS 2			BASIC NEEDS 3		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Human Capital Variables (real expenditure and consumption per head: quantities)									
	% Change								
Urb. Food Consump. . .	+11%	44	49	-13%	44	38.6	+11%	44	49
Rur. Food Consump. . .	+15%	18	20.7	+16%	18	20.9	+17%	18	21
Nat. Food Consump. . .	+74%	21	36.5	+29%	21.4	27.6	+51%	21	31.6
Urb. Health Exp. . . .	+113%	7.4	15.8	+117%	7.4	16.1	+116%	7.4	16
Rur. Health Exp. . . .	+210%	3.6	11.2	206%	3.6	11	206%	3.6	11
Urban Skilled % . . .		45.7%	71%		45.7%	73%		45.7%	62%
Rural Skilled % . . .		27%	36%		27%	37%		27%	44%
Demographic Variables									
Urban Birth Rate . . .		39.2	25.8		39.5	26.9		39.5	27.2
Urban Death Rate . . .		10.2	7		10.3	7.5		10.3	7.1
Urban Life Exp. . . .		62.2	68		62.2	67.3		62.2	67.9
Urban Natur. Incr. . .		2.9%	1.87		2.9%	1.9%		2.9%	2%
Aver. U.Nat.Incr. . .	2.3%			2.3%			2.5%		
Inmigration Rate(f) .	5%			4.4%			4.1%		
C-D Development Index Rural		128	301		127	327		127	392
Rural Birth Rate . . .		52.2	35.3		52.2	34.4		52.2	32.6
Rural Death Rate . . .		18.5	11		18.5	11		18.5	10.9

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VARIABLE	BASIC NEEDS 1			BASIC NEEDS 2			BASIC NEEDS 3		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables									
Rural Life Exp. . . .		49	60.7		49	60.7		47.2	61
Rural Nat. Incr. . . .		3.37%	2.42%		3.37%	2.3%		3.37%	2.1%
Aver. R.Nat.Incr. . .	3.3%			3.2%			3.0%		
Outmigration Rate(g) .	1.8%			1.4%			1.3%		
National Birth Rate .		50.1	31.1		50.7	31.5		50.7	30.5
National Death Rate .		17.4	9.24		17.5	9.7		17.5	9.5
National Life Exp. .		50.6	64		49	63.2		49	63.6
National Natur. Incr.		3.0%	2.2%		3.3%	2.1%		3.3%	2.1%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Immigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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6.5 Policy Assessment Under Competing Fertility Specification

The previous policy assessment stating that strong economic growth would not accelerate greatly the timing of the demographic transition was crucially dependent on the assumed rural fertility response to economic growth.

In essence, strong economic growth produced rapid rural-urban migration of skilled workers impeding the rise of educational levels in the country side. In addition, the real wage rate in rural areas did not increase, thus, a rise in the cost of children did not take place in order to reduce rural fertility. Nor the rise in rural life expectancy was sufficient to start reducing rural fertility. In sum, rural areas were kept below the threshold level, where the achieved health improvement translated into an increase in fertility. The national fertility level, thus, was reduced only because of urbanization, and this was not accelerated sufficiently by strong economic growth in order to reduce the national fertility level. In this context, it was seen that basic needs policies were the only ones which could break down the perverse rural fertility response.

If the rural fertility response to economic growth were different, the above policy assessment would be dramatically different. In the sensitivity analysis of chapter five, we found that a slightly more elastic response of rural fertility to income per head growth than the one of this analysis could not be ruled out. Although, it was mentioned that such an outcome was based mostly on recent findings pointing to a break down of the fertility behaviour prevalent until 1987 in Kenya, with evidence which is not still assessed [225]

With this caveat in mind, we proceed to the following exercise, in which the policies emphasizing economic growth and basic needs are simulated assuming this alternative fertility specification. In essence, urban fertility and rural fertility after a developmental threshold, are assumed to decline nonlinearly as income per-head rises. Before the threshold, rural fertility is positively affected by life expectancy, food consumption and time. The threshold level is assumed to be 1.3 times the initial level of income per head.

In table 6.5,[226] there are displayed the results of experiments which assume the same high rates of technological change and investment (rapid capital accumulation and economic growth) but different fertility specifications. The first experiment using the fertility specification BCASE1, was discussed in the previous section. The second experiment uses the above mentioned fertility specification, corresponding to BCASE2. The third experiment assumes a fertility specification corresponding to a modification of BCASE2 and a new mortality specification. The exposition is, however, centered mostly in the two first experiments.

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[225] These are the findings of the DHS survey explained before.

[226] All tables are located at the end of the section

The purpose of the exercise is just to illustrate the contrasting demographic evolution implied by the two fertility specifications.

The change in fertility evolution brought by the two specifications is, indeed, marked. The national crude birth rate in the experiment using the specification BCASE2, declines from 51 in 1970 to 34 per thousand in the year 2000. In the experiment using the specification BCASE1, the national crude birth rate declines only to 44 per thousand during the same period.

The urban crude birth rate in the year 2000 is practically the same in both experiments, around 28 per thousand. Thus, the outcome is due almost completely to the strong decline in the rural crude birth displayed in the experiment using the specification BCASE2. Indeed, the rural crude birth rate has declined from 52 to 39 in the latter experiment, while in the one keeping the fertility specification BCASE1, the rural crude birth rate has increased from 52 to 55.

The rate of population growth is also different. In the experiment using the fertility specification BCASE1, the rate of population growth is 3.38 percent. Moreover, the rate of natural increase is approximately the same in 1970 and 2000, around 3.3 percent. In the exercise using the specification BCASE2, the rate of population growth is 2.8 percent. The rate of natural increase at the initial period is 3.3 percent and declines to 2.3 percent in the year 2000. The rate of population growth is lower in the exercise using the specification BCASE2, because fertility declines faster than mortality. Indeed, mortality conditions in both experiments are similar.

The faster decline in the rate of population growth in the experiment using the specification BCASE2, because of several mechanisms explained at length before, produces a greater rate of growth of income per head. This, in turn, reinforces the decline in fertility, which feed backs in the rate of growth of income per head. This is the reason, why income per head rises in this exercise (RCA-BCASE2), 3.4 times instead of 3 times as in the exercise using the fertility specification BCASE1 (RCA-BCASE1).

In addition, the greater rate of growth of income per head and/or the lower rate of population increase produce a greater "relative" rate of urban growth in this exercise. That is, the rate of urban growth (7.1 percent) minus the rate of population growth (2.8 percent) is 4.3 in this case, while it is 3.9 in the RCA-BCASE1. In essence, the country urbanizes faster achieving a 45 percent of urban population in the year 2000, instead of 40 percent in the fertility specification BCASE1.

Greater levels of urbanization and faster urbanization have important dynamic implications in the reduction of national fertility. In simple terms, urban fertility is generally lower than rural fertility. Thus, the faster urbanization proceeds the faster should be the decline in national fertility. [227]The above slightly different relative rates of urban growth do not produce dramatic differences in the level of urbanization during the analyzed period. However, in a longer time-framework, the differential in urbanization that these rates produce is noticeable. For instance, in 45 years, the relative rate of urban growth of RCA-BCASE2 would produce an urbanization level of 83 percent, while the rate corresponding to RCA-BCASE1 would produce an urbanization level of 69 percent. [228]

In conclusion, under these assumptions, it is obvious that strong economic growth no matter if this is unbalanced, that urbanization presents a pattern of predominant informal sectors, that rural-urban migration drains skilled and educated manpower from the country side is the scenario leading more rapidly to a demographic transition.

In the third experiment, NEWCASE, it was assumed that the income elasticity of fertility increased in absolute value at a high level of income per head. This non-uniformity of the income elasticity of fertility underlies all hypotheses explaining fertility decline in function of changing tastes. Basically, they postulate that at certain moment of urbanization, income per capita and/or education, there is an important change in the parameters of the variables determining fertility (Donaldson, 1990). In addition, NEWCASE incorporated the mortality specification discussed previously. In essence, mortality becomes more elastic with respect to income per head.

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[227] Certainly, the process is more complex than this simplified assertion, as it has been explained before.

[228] The exercise has several qualifications, e.g., the rates are endogenous and they should decline. However, it can be used for illustrative purposes.

The results in columns 7, 8 and 9 of table 6.5 show in essence the same rate of population growth than in the specification BCASE 2, however, with substantially reduced rates of fertility and mortality. In sum, the national death rate is 9 in the 2000 in NEWCASE in comparison with 11.4 in the fertility specification BCASE2. The national crude birth rate is 24.5 in the 2000 instead of 33.9 in the fertility specification BCASE2. In essence, the experiment pursued to achieve a perhaps more realistic mortality decline than the one corresponding to the fertility specification BCASE2.

Reassessment of Basic Needs Policies

One could assume that basic needs policies raising educational and health levels of the population do not reduce fertility. Indeed, it has been argued that in Sub-Saharan Africa, increased primary education contributes to high fertility which otherwise would decline.[229] By the same reasoning, it has been argued that government expenditure in health care also contributes to high fertility (Bongaarts et. al., 1984; Anker and Knowles, 1983). Moreover, it has been argued that both educational and government health care advances by reducing the net cost of children contribute to maintain high fertility levels

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[229] It would decline because of undernourishment and low maternal health.

(Gomez, 1985; Page, 1988).[230]

If in addition, it is assumed that fertility declines only after a minimum level of income per head is reached, and thereafter the decline depends on the magnitude of growth of income per head, it is clear that policies delaying the growth of income will delay the demographic transition.

Under these assumptions, strategies of development which redistribute income in order to raise life expectancy and education, compromising economic growth will of course delay the demographic transition. The illustration of this situation is done below (table 6.6), by comparing two similar basic needs experiments with the different fertility specifications which we have called BCASE1 and BCASE2.[231]

The results illustrate dramatically the effect of the new fertility specification. The rate of growth of income per head declines from 2.5 percent in the basic needs experiment BCASE1 (BN-BCASE1) to 1.8 percent in the basic needs experiment BCASE2 (BN-BCASE2). This is due basically to the greater rate of population growth of experiment BN-BCASE2, 3.4 percent instead of 2.9 percent in experiment BN-BCASE1. The relative rate of urbanization is lower and thus the urbanization level in the year 2000 is also lower, 33 percent in BN-BCASE1 instead of 38 percent in BN-BCASE2. The external debt increases more, reaching 115 percent of GNP in 2000 instead of 46 percent.

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[230] The empirical evidence tends to support the evidence that above certain level of life expectancy and higher education, fertility starts declining (Birdsall, 1977; Birdsall et. al., 1979). Nevertheless, this level is not clear, in particular, for Africa. Indeed, Kenya is quoted as one case in which relatively high levels of life expectancy and education have not produced a decline in fertility (Frank and McNicoll, 1987; Faruqee and Gulhatti, 1983).

[231] The basic needs experiment corresponding to the fertility specification BCASE1, was presented before under the title basic needs without modernization (table 6.4). It is convenient to remind that this previous basic needs experiment assumed that technological change in small farms was a positive function of skilled labour retention. Thus, a decline in the proportion of skilled labour in the country side reduced technological change and vice-versa. As well, it was assumed that the expansion in education and health care was financed through a tax on profits.

The greater rate of population growth is of course a consequence of the lesser decline in fertility in this case (BN-BCASE2). Indeed, the national crude birth rate falls only to 41 per thousand in 2000, instead of 31 per thousand in the original basic needs experiment. Thus, the decline in mortality achieved by the basic needs policies, reducing the national death rate to 9.9 (in comparison to 12.8 approximately in the basic run corresponding to BCASEs 1 and 2), translates into a greater rate of population growth in BN-BCASE2 in relation to that of BN-BCASE1.

The lack of fertility response to basic needs policies in BN-BCASE2, has meant that the reduction in savings and investment necessary to finance them, has not generated compensating mechanisms through a decline in the rate of population growth. On the contrary, the rate of population growth has risen putting downward pressure on the marginal product of labour in the country side, reducing internal migration and thus efficiency gains. In sum, the motion of events generated by the basic needs policies in this case, leads to a reduction in the rate of growth of income per head. Thus, these policies retard the fertility decline.

In this context, it is obvious that a scenario of sustained economic growth even though basic needs are not met would lead to a faster fertility decline. It suffices to compare the results of the experiment of capital accumulation using this specification with these results (see table 6.5 above). In the rapid capital accumulation (RCA) experiment, income per head grows at a rate of 4.1 percent. Here, it grows at a rate of 1.8 percent. Consequently, the national crude birth rate declines faster in the RCA experiment, to 34 in the year 2000, in comparison to 41 in this case. Moreover, economic growth in the RCA may be considered as an auto-sustained process without external debt. Herein, economic growth is accompanied by a rise in external indebtedness which jeopardizes this process, and the gains which have been achieved in life expectancy.

TABLE 6.5

EXPERIMENT OF RAPID CAPITAL ACCUMULATION AND TECHNOLOGICAL CHANGE UNDER COMPETING FERTILITY SPECIFICATIONS

VARIABLE	R.CAPITAL ACCUM. FERTILITY BCASE1			R.CAPITAL ACCUM. FERTILITY BCASE2			R.CAPITAL ACCUM. FERT-MORT. NEWCASE		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP-National Income(a)-	7.1%	455	3844	6.9%	455	3630	6.9%	455	3642
Population	3.38%	5181	14310	2.8%	5181	12039	2.8%	5181	11879
Income per head(c) . .	3.7%	100	303	4.1%	100	342	4.1%	100	342
Index Food per head production		100	100		100	103		100	113
Urban Population . . .	7.3%	637	5660	7.1%	637	5379	7.2%	637	5488
Urban %		12%	40%		12%	44.7%		12%	46%
Rural Population . . .	2.1%	4544	8649	1.3%	4544	6620	1.1%	4544	6390
Rural %		88%	60%		88%	55.3%		88%	53.8%
External Balance Variables									
Deficit as % of GDP(d)		7.3%	-5%		b	-6.8%		b	-6.2%
Foreign Debt as % of GDP(d)	b	35%	-32%	b	35%	-39%	b	35%	-42%
Production: Sectoral Shares in GDP									
Agriculture	3.4%	39%	13%	2.9%	39%	11.6%	3.2%	39%	11.4%
Manufactures	10.7%	14.7%	44%	10.7%	14.7%	45.8%	10.7%	14.7%	45.7%
Services	6.8%	36%	32.6%	6.6%	36%	32.5%	6.5%	36%	32%
Housing	7.1%	6.4%	6.7%	7.1%	6.4%	6.8%	7.2%	6.4%	7.1%
Construction	6.7%	3.5%	3.1%	6.5%	3.5%	3.1%	6.7%	3.5%	3.3%

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VARIABLE	R.CAPITAL ACCUM. FERTILITY BCASE1			R.CAPITAL ACCUM. FERTILITY BCASE2			R.CAPITAL ACCUM. FERT-MORT. NEWCASE		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment									
Agriculture	2.1%	88%	60.5%	1.3%	88%	55.3%	1.2%	88%	53.8%
Manufactures	9.5%	2%	12.6%	9.4%	2%	14.6%	9.3%	2%	14.1%
Services	6.7%	10%	24.1%	6.1%	10%	27.3%	6.4%	10%	29.5%
Changes in Real Wages and Prices(e)									
	% Change								
Urban Aver. Wage . . .	+7%	219	235	+6.9%	220	234	+4%	220	228.5
Rural Wage	-4%	31	29.7	-9%	31	28.2	-6%	31	29.2
Nation. Averag. . . .	+108%	53.7	111.5	+123%	53.7	120.2	+125%	53.7	121.3
Price Index		1	8.8		1	8.8		1	8.77
Human Capital Variables (real expenditure and consumption per head: quantities)									
	% Change								
Urban Food Consumption	+13%	43.9	49.5	+12%	43.6	49.2	10%	43.9	48.1
Rural Food Consumption	+2%	18.4	18.8	-1%	18.3	18.1	0%	18.4	18.4
National Food Consp. .	+44%	21.5	31	+47%	21.3	31.5	50%	21.4	32.1
Urban Skilled % . . .		45.7%	58%		45.7%	57%		45%	56%
Rural Skilled % . . .		27%	20%		27%	18%		27%	16%

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VARIABLE	R.CAPITAL ACCUM. FERTILITY BCASE1			R.CAPITAL ACCUM. FERTILITY BCASE2			R.CAPITAL ACCUM. FERT-MORT. NEWCASE		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables									
Urban Birth Rate . . .		40	28.3		39	27.8		39	21
Urban Death Rate . . .		10.4	8.0		10.5	8.0		9.3	6.4
Urban Life Expectancy		61.8	66.2		62	66.2		62	67.4
Urban Natur. Increase		2.96%	2.02%		2.8%	1.97%		2.9%	1.5%
Aver. U.Nat.Incr. . .	2.44%			2.2%			2.2%		
Inmigration Rate(f) .	4.9%			4.9%			5%		
Rural Birth Rate . . .		52.2	55.3		52.4	39		52.4	27.6
Rural Death Rate . . .		18.7	13.4		18.4	14.2		16.9	11.3
Rural Life Expectancy		46.6	56.4		47.4	54.9		48.3	58.4
Rural Natural. Incr. .		3.35%	4.18%		3.4%	2.48%		3.6%	1.5%
Aver. Rural Nat.Incr.	3.65%			3%			2.9%		
Outmigration Rate(g) .	1.5%			1.7%			1.8		
National Birth Rate .		50.7	44.5		51	33.9		51	24.5
National Death Rate .		17.7	11.2		17.3	11.4		16	9.03
National Life Expec. .		48.5	60.3		49	60		50	62.6
National Natur. Incr.		3.3%	3.3%		3.3%	2.3%		3.4%	1.55%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Inmigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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TABLE 6.6

BASIC NEEDS POLICIES ASSESSMENT UNDER ALTERNATIVE FERTILITY SPECIFICATIONS

VARIABLE	BNEEDS BCASE1 FERTILITY			BNEEDS BCASE2 FERTILITY		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
GDP or National Income(a)	5.5%	455	2420	5.2%	455	2152
Population	2.97%	5181	12634	3.4%	5181	14149
Income per head(c) . .	2.53%	100	213	1.8%	100	172
Food per head production (index) . .		100	95		100	91
Urban Population . . .	6.8%	636	4824	6.7%	636	4741
Urban %		12%	38%		12%	33%
Rural Population . . .	1.8%	4544	7809	2.4%	4544	9407
Rural %		88%	62%		88%	67%
External Balance Variables						
Deficit as % of GDP(d)		3.6%	6.4%		8.7%	15.5%
Average Deficit . . .	0.8%			b		
Foreign Debt as % of GDP(d)	1.4%	30%	46%	b	30%	115%
Production: Sectoral Shares in GDP						
Agriculture	2.8%	39%	17.6%	3.1%	39%	21%
Manufactures	8%	14.7%	32%	7.1%	14.7%	26.2%
Services	5.8%	36%	40%	5.8%	36%	43%
Housing	b	b	b	b	b	b
Construction	b	b	b	b	b	b

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VARIABLE	BNEEDS BCASE1 FERTILITY			BNEEDS BCASE2 FERTILITY		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Employment: Sectoral Shares in Total Employment						
Agriculture	1.8%	88%	62%	2.4%	88%	67%
Manufactures	7.9%	2%	9%	73%	2%	6.5%
Services	6.2%	10%	26.5%	6.5%	10%	25%
Housing	b	b	b	b	b	b
Construction	b	b	b	b	b	b
Changes in Real Wages and Prices (e)						
	% Change					
Urban Average Wage	-13%	218	190	-21%	219	174
Urban Modern Wage	-14%	152	131.6	-19%	152	122.5
Urban Informal Wage	-5%	103	98	-12%	109	95.6
Rural Wage	+14%	31	35.1	-2%	31	30.4
National Average	+76%	53.6	94	+45%	53.7	78
Price Index		1	8.39		1	8.3
Human Capital Variables (real expenditure and consumption per head: quantities)						
	% Change					
Urb. Food Consump.	+13%	44	38.6	-16%	43.6	36.5
Rur. Food Consump.	+16%	18	20.9	+8%	18.3	19.8
Nat. Food Consump.	+29%	21.4	27.6	+18%	21.3	25.3
Urb. Health Exp.	+117%	7.4	16.1	+122%	7.3	16.2
Rur. Health Exp.	206%	3.6	11	200%	3.6	10.8
Urban Skilled %		45.7%	73%		45.7%	76%
Rural Skilled %		27%	37%		27%	43%

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VARIABLE	BNEEDS BCASE1 FERTILITY			BNEEDS BCASE2 FERTILITY		
	Growth rate (annual)	1970	2000	Growth rate (annual)	1970	2000
Demographic Variables						
Urban Birth Rate		39.5	26.9		39	33
Urban Death Rate		10.3	7.5		10.3	7.6
Urban Life Exp.		62.2	67.3		61.8	67.1
Urban Natur. Incr.		2.9%	1.9%		2.8%	2.5%
Aver. U.Nat.Incr.	2.3%			b		
Inmigration Rate(f)	4.4%			b		
C-D Development Index						
Rural		127	327		b	b
Rural Birth Rate		52.2	34.4		52.2	45.1
Rural Death Rate		18.5	11		18.5	11
Rural Life Exp.		49	60.7		47.2	60.8
Rural Nat. Incr.		3.37%	2.3%		3.37%	3.1%
Aver. R.Nat.Incr.		3.2%			b	
Outmigration Rate(g)		1.4%			1.3%	
National Birth Rate		50.7	31.5		50.7	41.1
National Death Rate		17.5	9.7		17.5	9.9
National Life Exp.		49	63.2		49	63
National Natur. Incr.		3.3%	2.1%		3.3%	3.1%

a. GDP defined in millions of Kenyan pounds 1969.
b. Results not presented (unnecessary or negligible)
c. Income per head defined in index terms.
d. GDP at market prices
e. Wages in 1969 Kenyan pounds
f. Immigration rate defined as annual rate of urban growth minus the average rate of urban natural increase.
g. Outmigration rate defined analogously.
Note 1 :C-D development index corresponds to the Cobb-Douglas combination of variables determining fertility.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.
Note 2: The displayed values for the year 2000 of some of the variables are actually average values for the two years 1999-2000. These variables are GDP, income per head, deficit, sectoral shares of production and employment, wages and price index.

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7. CONCLUSIONS

This thesis has examined the economic and demographic context of high fertility rate regimes which currently characterize the modern economies of Sub-Saharan Africa. The object was not to estimate the determinants of fertility in such countries. Here we relied upon the prevailing evidence of demographers to glean a perspective into the key factors which drive such high fertility rates.

Fertility was modeled seeking to achieve a consistent representation of Kenyan fertility trends. The consensus in the demographic literature is that fertility decline in Kenya has been extremely slow at least until 1987. This general trend could be captured by different fertility specifications. In view of this methodological issue, competing fertility specifications were used in the CGE model to approximate the stylized economic and demographic changes of the modeled economy. The ability to approximate these changes would then be a key factor in choosing a fertility specification.

Two results arise from this sensitivity analysis. Those specifications which draw heavily on the view that fertility has an inverted "U" relation with development (i.e. the supply-demand view of Easterlin and Crimmins [1985]) appear more consistent with the stylized facts of development as least as replicated by our model. Other views which link fertility solely and negatively to income per capita are not in the context of this model consistent with the stylized facts of development and demographic change in the region.

With regard to fertility change, the specification denoted BCASE1 adjusted better to the available data until 1987. In essence, this specification shows rural fertility mildly increasing and urban fertility declining. The overall result is an extremely slow decline in the national fertility level even with a mild increase in one of the initial periods. The specification (BCASE2), which entailed an inverted U shaped relation between rural fertility and income per capita, also replicated fairly well fertility change. In particular, BCASE2 replicated better than BCASE1 the available fertility evidence after 1987. This specification showed that rural fertility increases initially but it starts declining during the last 10 years of the simulated period. The decline in urban fertility was similar to the one of BCASE1.[232]

Specification BCASE3, which postulates a negative relationship between income per capita and fertility in rural and urban areas, produces a too fast decline in fertility which is inconsistent with the actual data. The economic changes associated with the specification point to subtle departures from the stylized facts of the modeled economy, which as a whole suggest the inconsistency of this specification.

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[232] The result pointed to several possibilities. For instance, specification BCASE1 may exaggerate the level of the rural threshold or measure it incorrectly. Another possibility is that the information regarding a significant fertility decline in 1987 in Kenya is simply incorrect.

The specification BCASE1, was retained for most of the analysis because of its more comprehensive treatment of fertility more in agreement with demographic theory. Specification BCASE2, was retained to replicate the assessment of some policies which were too heavily contingent on the fertility specification.

The ability of the model to replicate broadly the stylized features of modern Sub-Saharan economies lead us to the next step of using the model as a policy simulator. A variety of competing policy prescriptions were assessed in terms of their effect of measures on economic and demographic change relative to a base case in which such policies are absent.

Policy Assessment and Theoretical Conclusions

Under the assumptions of the fertility specification BCASE1, it was shown that even in a strong economic growth scenario the demographic transition would not be accelerated greatly during the period of time examined.

In this scenario, rural fertility would rise to its natural limits driven by better nourishment conditions. Urban fertility, instead, would decline faster because of the increase in urban real wages and the rise in life expectancy. The increase in life expectancy was mostly explained by the increase in the real wages and food consumption. The national fertility level would decline because of the combined effect of both a greater level of urbanization and the lower level of the urban crude birth rate. In sum, a doubling in income per head reduced the national crude birth rate only by three additional points in the year 2000 (from 51 to 44 instead of 47).

The ultimate cause of the slow decline in the national fertility level is given by the perverse fertility response in the countryside. This response, in turn, is due to the fact that the rural population stays at the left of the threshold. The determinant factors in this outcome are the stagnation of real rural wages and the decline in the proportion of educated people in the countryside. The latter caused precisely by the phenomena of strong economic growth. In sum, the index measuring the quality of life of the rural population does not increase (only life expectancy rises).

Strong economic growth promotes the decline in national fertility into a great extent through its effect on accelerating urbanization and rural-urban migration. These processes by increasing efficiency through the economy reinforce economic growth. For the horizon of time analyzed (1970-2000), however, the doubling in the rate of growth of income per head produced only 6 additional points of urbanization (40 percent urban in 2000 instead of 34 percent). This differential is insufficient to produce a major decline in the national fertility level.

One could speculate that a continuation of the high rate of urbanization associated with strong economic growth would lead rapidly the country toward a high level of urbanization at the begining of the 21st century e.g. 70

percent approximately in the year 2015, if the conditions of growth remain. This higher urbanization level, in turn, could produce a significant decline in the national fertility level.[233]

The model experimentation with different rates of economic growth and other simulation experiments point to several theoretical elements in explaining a slow demographic transition in dualistic economy with an initial sizable surplus population.

The real wage rate in urban and in rural areas cannot increase rapidly and substantially even in conditions of strong economic growth. It will do it only after a substantial part of the rural surplus population is absorbed. This is a result suggested from all experiments undertaken.

The real wage of the average worker of the country (average between rural and urban) does increase even if rural and urban wages are stagnant. It does because of the sizable shift of population from rural to urban areas where real wages are higher. The degree of increase is directly related to the rate of growth of income per head and inversely related to the one of population growth. This is again another consistent result of all simulations.

Hence, under a theoretical framework which draws on the value of time (as a proxy for the cost of children) for explaining fertility, it is hardly possible to expect rapid declines in fertility under conditions such as those of Kenya. It is also predictable that the only noticeable decline in fertility at the initial stages of development has to be that associated with the urbanization process. This makes sense of the demographic evidence stating that the gap in rural-urban fertility widens sharply at the first stages of development.

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[233] The assessment of this possibility goes beyond the task here. There are as well uncertain elements in it. For instance, the rate of urbanization is endogenous and it is expected to decline on time.

Extremely rapid rural-urban migration is an unavoidable result of highly dualistic economies, where urban economic growth tends to be more dynamic. On the one hand, rural-urban migration does contribute to the dynamism of the economy and improves income distribution. On the other hand, it may reduce the dynamism of the economy by contributing to maintain the conditions for rapid population growth in the country side. In this model, the positive effects of rural-urban migration outweigh its negative effects.

Institutional protection of modern sector wages may delay the demographic transition. Specifically, it was shown that a higher degree of protection of modern sector wages did increase the national crude birth rate. Basically, this greater protection reduces by more than half the rate of growth of income per head, produces a substantially greater external debt and reduces dramatically urbanization (from 34 to 26) and rural-urban migration. All of these effects evaluated in more dynamic terms would have a stronger effect in reducing the probabilities for a rapid demographic transition.

The reduction of the rate of population growth in this model with clear Malthusian characteristics does have strong positive effects on the rate of growth of the economy (income per head) and on the real wage rates.[234] Furthermore, in this model rapid population growth reproduces the conditions for the continuation of high fertility rates, essentially through its effect on the real wages. In addition, rapid population growth makes difficult a more rapid rate of urbanization by reducing the rate of economic growth.

One can relax the assumptions of the fertility specification BCASE1. For instance the level of the rural threshold can be reduced and fertility determination can be made independent of the real wage rate, high education and life expectancy. This is approximately what the fertility specification BCASE2 entails, by specifying rural fertility as an interactive function of income per capita (positive and negative). If this is a realistic fertility specification, strong economic growth will have a much greater impact on reducing fertility than in the above scenario. In general, the intensity of the "population problem" is substantially reduced.

Certainly, this would be a very benign situation for those modern stylized Sub-Saharan economies seeking to reduce their fertility level e.g. Kenya. This is so, because even with an unexceptional rate of growth of the economy it was shown that their national crude birth rate would decline from 51 in 1970 to 41 in 2000 instead of 47 in the specification BCASE1. In conditions of strong economic growth it was shown that the decline would be more rapid from 51 in 1970 to 34 in the 2000, instead of 44 as in BCASE1.

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[234] In strict functional language, the rate of population growth affects negatively the rate of growth of income per head.

The economic-demographic dynamics associated with the fertility specification BCASE1, lead to the conclusion that the conditions generating high rural fertility must be eliminated. Indeed, the rural perverse fertility response is determinant in maintaining a high rate of population growth, reducing the rate of growth of income per head and the rate of urbanization, and slowing the increase in the average real wage rate. In addition, the model under this specification shows that not even economic growth could break this fertility response before the year 2000.

In this sense, basic need policies by altering those determinants of rural fertility which are institutionally modifiable, specifically rising health expenditure and massively expanding education may shift the rural population to the right of the threshold and produce the decline in fertility. The reader is cautioned to recall that the specification of fertility may make the outcome predictable since the variables which influence fertility are precisely the variables which a basic needs program attempt to modify.[235]

There are several fairly realistic conditions under which these policies conditions can fail. The real assessment of these policies is really to evaluate the capability for the economy in generating a gigantic expansion in social expenditure. This capability rests mainly on the possibility of generating simultaneously economic growth and income redistribution. On the other hand, the success of the policy also rests upon the conditions that adult education and substantially improved health levels do affect fertility negatively.

The simulations illustrate these different possibilities, suggesting that these policies can indeed work albeit under circumstances which some will judge as unrealistic. The simulation experiments also illustrate clearly that if the above conditions do not held, economic growth even unbalanced, has much greater chances of reducing fertility in the modeled economy.

Contribution of the Thesis

The main contribution of this thesis might be viewed in its attempt to integrate demographic behaviour into the core of a dualistic economy. That is, demographic trends in the version BCASE1 of this model emerge from the particular functioning of this dualistic economy. For instance, rapid rural urban migration is a phenomenon intrinsically associated with high fertility and this dualistic structure. Patterns of urbanization with a predominance of the informal sector tend to produce high urban fertility and mortality. Strong economic growth drains the country side of talented manpower and keeps relatively high rural fertility and mortality. On the other hand, economic growth does improve income distribution and accelerates economic growth. The government attempts the difficult task of erasing rural-urban wage differentials and rural-urban educational gaps and services differentials. wind.

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[235] Under this fertility specification, the success of these policies depend on preventing a deterioration in the rural wage rate level and on increasing the retention of the skilled population in the country side.

The assessment of policies which this thesis does, operates within these constraints and must be understood within these constraints. Finally, the policy assessment of the thesis is only "suggestive" not conclusive. Indeed, the thesis is not based on parameters which have been statistically tested. Nor we claim that the approximation provided by the model to the stylized facts of development is a proof that our fertility specification is the correct one.

Main Limitations of the Research

It is convenient to warn the reader about some important limitations of this model. The inability of the model to capture important social and cultural dimensions of development constitutes perhaps its most important limitation. These dimensions might be particularly relevant for demographic analysis. For instance, the cases of the "early demographic transitions" of e.g. Kerala and Sri Lanka, most probably explained by sociocultural factors, could not be totally assessed nor understood in the framework of this model. Our imperfect attempt of assessing the demographic impact of accelerated education expansion and of modeling changes in fertility tastes and cultural values regulating fertility, constitute perhaps a minor step in the required direction. However, there is a vast task ahead in integrating the social dimensions of development in the modeling of population phenomena in the Third World.

In the economic side of the model, it is necessary to mention that the model exaggerates the occurrence and intensity of economic cycles. This is mostly product of the relatively high level of sectoral disaggregation, combined with a low degree of capital mobility. A lesser degree of sectoral disaggregation would have eliminated most of these oscilations, however, at the cost of a loss in the analytical insight provided by the model. For instance, it would have been impossible to highlight the important and realistic role played by the urban informal sector on fertility, mortality and internal migration.

Finally, it must be said that this is not a closed general equilibrium model. Specifically, trade and/or government deficits were assumed to be covered by foreign savings. Certainly, this behaviour of foreign savings can be justified only under certain particular conditions, which we believe were present in Kenya and in several Sub-Saharan countries until the late eighties. Of course, this form of modeling foreign savings required of caution in the assessment of policies. In particular, it required realism with respect to the fact that the external borrowing capacity of the modeled economy is not endless. Hence, the success of policies was also assessed on the basis of their capacity in reducing the increasing external indebtedness trend of the stylized economy.

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